CHEMISTRY IN NEW ZEALAND

JOURNAL OF
THE NEW ZEALAND
INSTITUTE
OF CHEMISTRY

Vol. 35, No. 3, June, 1971

CHEMISTRY IN NEW ZEALAND

Journal of The New Zealand Institute of Chemistry

Vol. 35, No. 3, June, 1971

Published bi-monthly by the New Zealand Institute of Chemistry Inc. (P.O. Box 250, Wellington)

Contents

Editor:
Editor: Miss J. Mattingley, M.Sc., A.N.Z.I.C.
P.O. Box 250, Wellington.

Advertising Manager:
D. Howard, M.Sc., A.N.Z.I.C.
P.O. Box 250, Wellington.

Printed by David F. Jones Ltd., Wellington.

Distribution. The Registrar:
D. J. Hogan, B.Sc., A.N.Z.I.C.
P.O. Box 1926, Christchurch.

Honorary General Secretary:
Prof. W. E. Harvey, M.Sc., Ph.D., F.N.Z.I.C.
P.O. Box 250, Wellington.

Employment Officer:
E. S. Borthwick, M.Sc., A.R.I.C., A.N.Z.I.C.
P.O. Box 2091, Wellington.

The Journal of the N.Z. Institute of Chemistry has an audit circulation Certificate of New Zealand Advertisers. Latest audited circulation (March 1969) 1150.

CLINICAL CHEMISTRY CONTROL PRODUCTS

the
essentials for

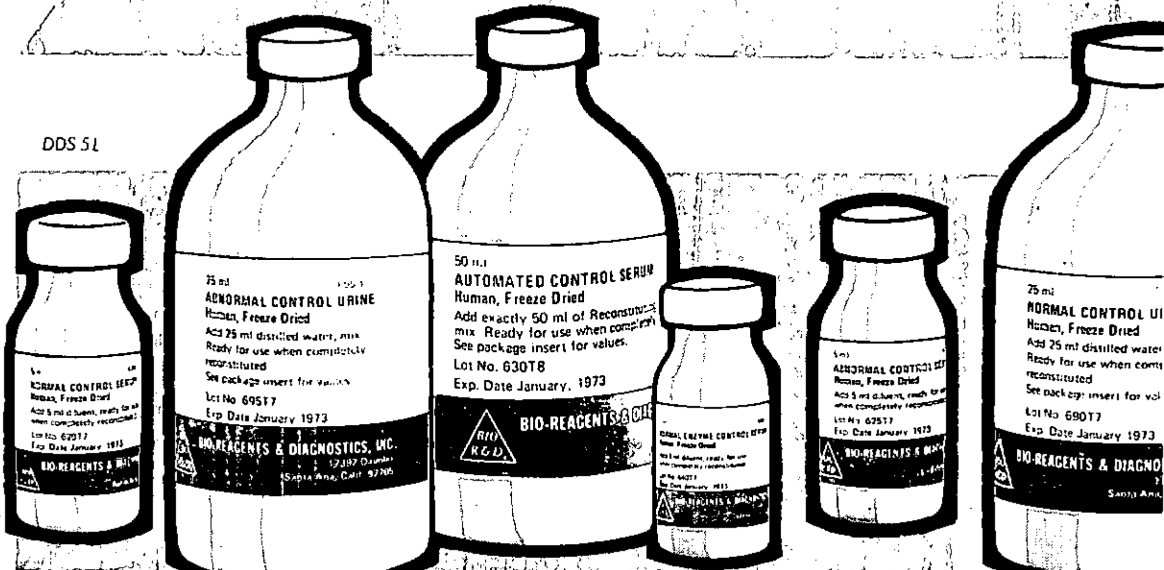
QUALITY CONTROL

PROCEDURE MONITORING

RELIABILITY CHECKING

confidence

DDS 51



GENERAL DESCRIPTION AND USE.

All Bio — R & D control products are of human origin carefully processed and freeze-dried (lyophilized) for maximum stability during shipment and storage. Reconstitution must be with distilled or de-ionized water except for the Automated Control Serum where a special reconstituting fluid accompanies the serum. After reconstitution, the stability of the various constituents of the controls is the same as if in a laboratory specimen.

Assays have been performed by at least three reference clinical laboratories. Methods of assay and assay results are supplied in the form of a direction insert in each package. After reconstitution, the control products are to be tested in the same manner as unknown specimens. If results obtained are the same as the direction insert values (within normal limits of variation), test procedures are considered "in control", and thus, specimen values may be reported with confidence. Significantly different values from those reported in the direction insert indicate "out of control" conditions exist, and immediate efforts to discover the source of difference are necessary to produce reportable results.

NORMAL CONTROL SERUM, HUMAN, DRIED. (Catalogue No. 620) 6 x 5 mls

Serum derived from healthy humans containing all constituents usually found in serum at "normal" concentrations.

ABNORMAL CONTROL SERUM, HUMAN, DRIED. (Catalogue No. 625) 6 x 5 mls

Human serum similar to NORMAL CONTROL SERUM except constituents are present in concentrations usually considered "abnormal" or clinically significant.

AUTOMATED CONTROL SERUM, HUMAN, DRIED. (Catalogue No. 630) 10 x 50 mls

Human serum processed in same manner as all other Bio — R & D control products. Assays have been performed using automated equipment and methods of the Technicon Instruments Corporation (Chauncey, New York). To be used for the control of automated procedures as opposed to manual methods.

NORMAL ENZYME CONTROL SERUM, HUMAN, DRIED. (Catalogue No. 640) 6 x 3 mls

Human serum carefully processed and freeze-dried so as to preserve the most delicate enzymes normally found in serum. Assayed by the reference laboratories using a variety of methods and reported in various popular enzyme units.

ELEVATED ENZYME CONTROL SERUM, HUMAN, DRIED. (Catalogue No. 645) 6 x 3 mls

Human serum similar to NORMAL ENZYME CONTROL SERUM except enzymes present in concentrations usually considered abnormal or elevated. In conjunction with NORMAL ENZYME CONTROL SERUM, may be used to establish standard or reference curves for enzyme assays.

ELEVATED CHOLESTEROL CONTROL SERUM, HUMAN, DRIED. (Catalogue No. 650) 6 x 5 mls.

Serum derived from humans whose serum possesses high concentrations of cholesterol. Particularly applicable to the control of all cholesterol assay methods since the cholesterol occurs in its natural state (i.e., physiologically bound to protein).

ELEVATED BILIRUBIN CONTROL SERUM, HUMAN, DRIED. (Catalogue No. 660) 6 x 3 mls.

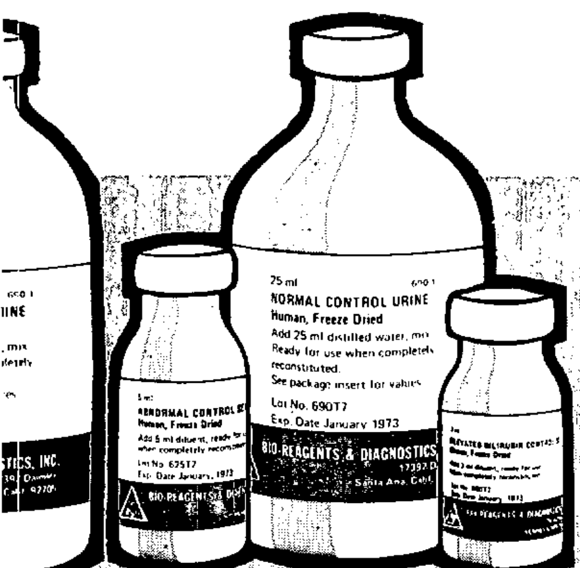
Human serum processed in same manner as all other Bio — R & D control products. Supplemented with bilirubin meeting nationally — established criteria of purity. Therefore, may be used as a secondary reference as well as a control serum.

NORMAL CONTROL URINE, HUMAN, DRIED. (Catalogue No. 690) 4 x 25 mls.

Urine derived from healthy humans and containing constituents usually found in urine specimens in "normal" concentrations including hormones associated with pregnancy. Processed in the same manner as all other Bio — R & D control products. Designed specifically for the control of assay procedures using urine as the specimen.

ABNORMAL CONTROL URINE, HUMAN, DRIED. (Catalogue No. 695) 4 x 25 mls.

Human urine similar to NORMAL CONTROL URINE except constituents are present in concentrations usually considered abnormal. In addition, assays are supplied for some constituents which would not normally occur in measurable amounts in urine.



DDS 5 R

Bio-Reagents & Diagnostics, Inc.

Sole New Zealand Agents

DIAGNOSTIC DIVISION

DOMINION DENTAL SUPPLIES LTD.

Auckland, Wellington, Christchurch

PUBLIC NOTICE

Inserted by direction of the Commissioner of Trade Marks

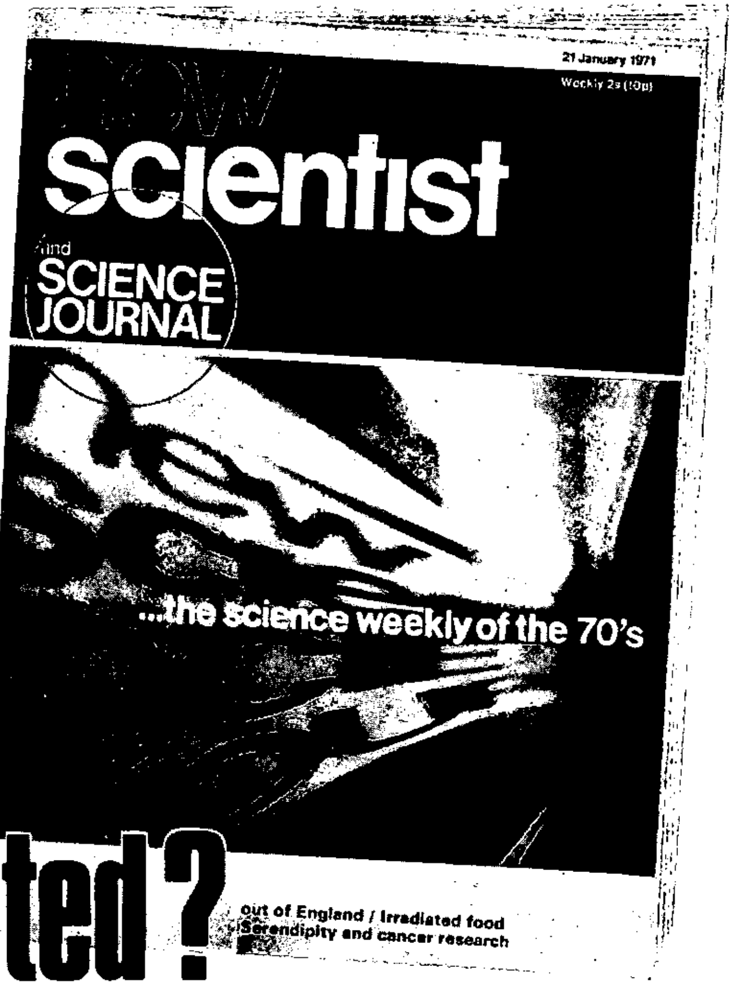
ASSIGNMENT WITHOUT GOODWILL

Trade Mark No. 38040
B.D.H.

Chemical substances used in manufactures, photography and philosophical research. (Third Schedule, Class 1).

The trade mark was assigned on the 16th day of November, 1970, to BDH PHARMACEUTICALS LIMITED, of Birkbeck Street, London, E., England, manufacturers, by BDH CHEMICALS LIMITED (formerly THE BRITISH DRUG HOUSES LIMITED) of Clarges House, 6-12 Clarges Street, London, W., England, merchants, without the goodwill of the business in which it was then in use.

is science being prostituted?



In many areas the misapplication of scientific knowledge and skill is painfully obvious. For example, the development of a napalm that sticks more efficiently to the victim. The gulf between science and society is everywhere of growing concern. This stimulating new magazine scrutinizes the wider implications of the dilemma and provides an international forum for its discussion.

New scientist is the result of a merger between the original "New Scientist" and "Science Journal". A brilliant new publication has been sparked off in the process. A glance at the titles of some of the articles in the new issue gives some idea of its scope —

- RADIATION FOR FRESHER FOOD
- CANCER CHEMOTHERAPY
- BIG ENGINE AERODYNAMICS
- SCIENCE IN NORTH VIETNAM
- COMPOSITE FUTURE FOR STRENGTH FIBRES
- A PAUCITY OF PANCREAS
- LASERS — A COHERENT APPROACH TO ART

And many more fascinating features of great interest both to scientist and layman, all clearly written and dynamic in their approach.

new scientist

Obtain your copy of the new edition of **new scientist** now. At all newsagents and bookstalls. **Price 30 cents.**

UTILISATION OF N.Z. NATURAL PRODUCTS*

R. C. Cambie

M.Sc., Ph.D. (N.Z.), D.Phil. (Oxon.), D.Sc.(Auck.), F.R.S.N.Z.

University of Auckland

When natural products are considered, it is usually accepted that there exist basic patterns of primary metabolism on which various organic systems impose only relatively minor modifications. On the other hand there are pathways of secondary metabolism that lead to compounds which are restricted in taxonomic distribution, which are not formed under all conditions, and which have no obvious metabolic function. These latter compounds are referred to as natural products, the term usually being restricted to the products of secondary metabolism. Although possessing chemical interest as well as metabolic importance, the primary metabolites such as amino acids and the fundamental polymers such as the nucleic acids, proteins and lignins are normally excluded from consideration.

Many of these natural products have been and still are utilised throughout the world for various purposes. It is the purpose of this article to summarise briefly some of the work which has been carried out in the past or which is currently being done with the aim of utilising New Zealand natural products.

* This article is based on the text of an address delivered to the Canterbury Branch of the New Zealand Institute of Chemistry on June 15, 1970, and to the Auckland Branch of the Institute on June 24, 1970. At the latter meeting Professor Cambie was presented with The New Zealand Association of Scientists' Research Medal for 1969.

† *See page* 75

Kauri Gum

Perhaps one of the best known New Zealand natural products to have been utilised commercially is kauri gum. Kauri gum was first exported to London as an experimental consignment in the 1830's. Between 1845 and 1900, production increased rapidly as gumfields opened up in Northland and Coromandel, reaching its peak in 1905 when about 11,000 tons were produced. At the same time the price gradually rose to reach a peak of $166 per ton in 1920. Although some 7,000 tons were exported in 1924, production decreased and dwindled to small amounts over the next 10 years, and by 1950 the industry was virtually defunct. The gum was originally used by varnish makers in England and the U.S.A. because it united with linseed oil faster and at a lower temperature than any other resin of a comparable nature. Later it was used mainly for the production of linoleum.

Rather surprisingly, very little chemical work was carried out on the constituents of kauri gum until recently. Early work was carried out by Hosking[1] who in 1929 isolated the diterpenoid, agathic acid (1)† in addition to the common terpenes, α-pinene and limonene. But it wasn't until 1964 and 1966 that Gough[2] in London and Thomas[3] at the D.S.I.R. in Wellington investigated the bled resin and isolated a series of diterpenoid acids (*viz.* abietic, *cis-* and *trans-* communic, sandaracopimaric, and agathic acids) and their corresponding alcohols. Although kauri gum is apparently still plentiful in the North, to dig it up on the large scale is now uneconomic, and with the advent of plastic tiles it is very doubtful if we shall ever see a revival of the kauri gum trade.

Solasodine

In recent years *Solanum* alkaloids and especially one called solasodine (2) have received increasing interest and significance as possible materials for the industrial production of hormonal steroids. Considerable chemical work has been carried out on *Solanum* alkaloids including some important work at Auckland. This is illustrated by a quote from Fieser and Fieser's classic book on steroids[4]—"Although other early observations are on record, modern work in the [*Solanum*] field was initiated in 1942 by Briggs at Auckland, New Zealand." Briggs was in fact the first to elucidate the chemical structure of solasodine, which occurs as its glycoside solasonine in the New Zealand native plant, *Solanum aviculare*[5]. This plant is closely related to one called *Solanum laciniatum* which is of common occurrence overseas. *S. laciniatum* appears to be the best source of solasodine, and numerous papers particularly from the Soviet Union, Hungary, and more recently India and China, describe the botanical and agronomical problems concerned with large scale cultivation of *S. laciniatum,* including its cropping and the isolation of solasodine. The solasodine content of selected high-yielding strains is reported to be up to 2.2% of the dried aerial parts of the plant, and the average yield to be 10-12 kg per acre[6].

Ivon-Watkins Dow Ltd. in New Plymouth have been interested in the possible utilisation of solasodine from *S. laciniatum* for about 10 years. Dr. E. G. Brooker, their chief research chemist, has informed me that they have learnt quite a lot about the growing and harvesting of *S. laciniatum*, but he emphasises that their work is still in the preliminary stages and at present could hardly be classified as a commercial venture. Cropping trials are also being carried out by the Crop Research Division of the D.S.I.R. in Canterbury.

The value of solasodine lies in the fact that it can be converted to pregnane derivatives which serve as intermediates in the synthesis of hormones such as progesterone (3), and thence of cortisone (4) and related substances for therapeutic use in the treatment of arthritis and similar metabolic diseases. A number of methods of degrading solasodine to pregnane derivatives have been reported, and there has been considerable competition between various groups of workers to improve both the procedure and the yields of various steps.

Perhaps the most superior modern procedure is the following sequence[7].

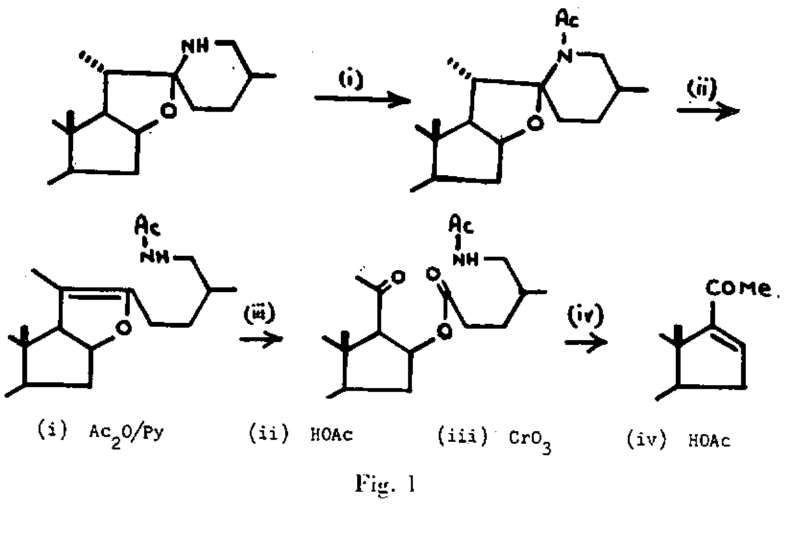


Fig. 1

The first step involves acetylation, the second a prototropic isomerisation with acetic acid, the third an oxidation with chromium trioxide and then finally a cleavage of the side-chain with boiling acetic acid. In a continuous operation from solasodine without isolation and purification of the intermediates, an overall yield of 65-68% of the final product (3β-acetoxypregna-5,16-dien-20-one) can be obtained.

Another method[8] which is based on earlier work by Briggs[9] is detailed below (Fig. 2).

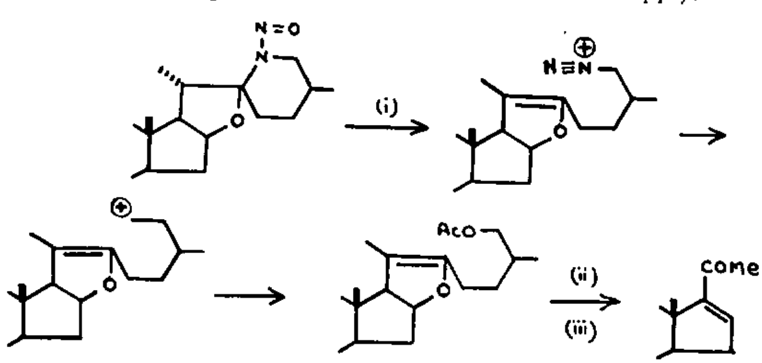
The first step is an acid-catalysed isomerisation of n-nitroso-o-acetylsolasodine to an unstable diazonium ion which decomposes with the liberation of nitrogen. Nucleophilic addition of acetate ion gives on acetate which is oxidised as before. Here the overall yield is about 30%.

The greatest unknown in the possible utilisation of solasodine in this country is the economics of its production. While supplies of the normal starting material diosgenin (5), which is obtained from the Mexican yam, remain good and the price relatively low, the economics of solasodine production do not appear to be particularly attractive. Also, the situation is confused by the commercial total synthesis of some steroids and the use of non-steroidal anti-inflamatory drugs. Microbiological transformations are also enabling the cheaper synthesis of hitherto relatively inaccessible starting materials.

Manool

Considerable interest has been evoked both here in New Zealand and abroad in a bicyclic diterpenoid called manool (6) which is obtained in yields of up to 6-8% from the New Zealand "pink pine" *Dacrydium biforme*. Swiss chemists have established a relationship between ambrienolide (7), one of the major oxidation products of ambergris (a concentration from the sperm whale) and the diterpenoids manool and sclareol (8) (from the sage, *Salvia sclarea*). They have also carried out extensive work on the production of synthetic substitutes for odoriferous compounds derived from ambreinolide starting from the plant materials. For example, manool has been degraded by potassium permanganate or osmium tetroxide-sodium periodate oxidation to internal acetals which have the strongest ambergris-type odour yet known. A semi-industrial production of these acetals has been reported by Demole[10] in which manool is selectively epoxidised and the resulting epoxide is subjected to ozonolysis. (Fig. 3.)

This means that there is considerable potential for manool as a starting material for the preparation of synthetic perfumes, and a number of firms have atttempted to export manool. A survey by the N.Z. Forest Service has shown that there are sufficient trees on the West Coast of the South Island to supply 20 tons of manool



(i) $HOAc/NaOAc/Ac_2O$ (ii) $CrO_3/HOAc$ (iii) $HOAc/\triangle$

Fig. 2

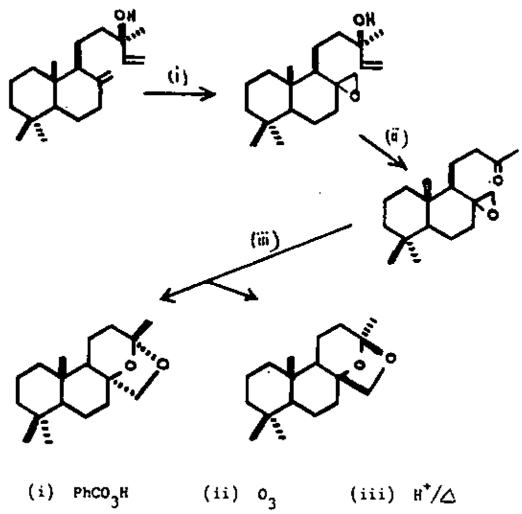


Fig. 3

for a period of 25 years. Initially a price of $16 per pound was offered for crude manool and an Auckland firm supplied some 500 lbs as a trial shipment which I understand was successfully employed in perfume manufacture. The related compounds manoyl oxide (9) and ketomanoyl oxide (10) will be discussed under current attempts to prepare compounds with ambergris-type odours.

Turpentine

Another natural prodcut which is receiving increasing interest is N.Z. sulphate turpentine which is produced mainly from our exotic pines such as *Pinus radiata*. While this tree is not a native species, a visitor to New Zealand could well be excused for thinking it was so, for the tree flourishes in many man-made forest of the country. Ivon-Watkins Dow Ltd. have a unit (recently taken over from A. C. Nottinghams Ltd.) in Christchurch which fractionates turpentine into α-pinene (11) and β-pinene (12), and produces α-terpineol (13) by hydration of the former compound. Terpineol is one of the major terpenoids used in the perfumery industry and is the basic raw material for the preparation of many important flavour and perfumery materials, e.g. citronellol, geraniol, and because of this, world production of turpentine is more than five times the total of all other oils.

I understand that both Tasman Pulp and Paper and Forest Products Ltd. in Auckland and A. C. Nottinghams Ltd. have exported shipments of turpentine, and that work on turpentine production has also been carried out at the D.S.I.R. Although N.Z. pine oil is alleged to have a particularly high content of β-pinene[11], it is apparently of considerable commercial value being used increasingly in the manufacture of adhesives for cellotape, etc. Dr. M. P. Hartshorn of the Chemistry Department, University of Canterbury, is working in conjunction with Ivon-Watkins Dow and as part of his research programme, is investigating the ring rupturing processes of pinane derivatives under pyrolytic and photolytic conditions. His objectives are two-fold. Firstly, he is concerned with the mechanism of bond breaking and in which order the bonds of the pinanes are broken; secondly, he is investigating the commercial significance of certain products which are formed.

Miscellaneous Products

Various other N.Z. natural products have been utilised at various times. For example in 1931, 55 tons of Tanekaha (*Phyllocladus trichomanoides*) bark were exported for a return of $1380, the material presumably to be used in the tanning industry. *Phormium tenax* (N.Z. flax) has been of commercial importance in the past, the peak year being 1916 when 27,500 tons of fibre valued at *ca.* $6 million were exported. However, the flax is valued for its fibre and not for its natural products.

In a monograph published in 1961, Brooker and Cooper[12] have listed the economic plants of New Zealand. They point out however, that very few are of value for their natural products and, indeed, despite the distinct nature of the N.Z. flora, few plants have been exploited commercially.

A very recent development has been the isolation from plant sources of polar steroids which show marked moulting hormone activity when injected into insects. These hormones initiate the pupal and larval stages through which an insect grows to maturity. The uptake of excessive amounts of these compounds causes a lethal dearangement of their development, i.e. they act as insect killers. These compounds, called ecdysones (e.g. 14), were originally isolated from insects and crayfish where they occur in extremely small amounts. Dr. G. B. Russell of the Applied Biochemistry Division of the D.S.I.R. at Palmerston North has carried out a survey of the New Zealand gymnosperms and has shown that a high proportion of them show moulting hormone activity[13]. The commercial value of such compounds is fairly obvious, but rather surprisingly in view of New Zealand's problems with insect control and the recent banning of D.D.T., and despite intense investigation overseas, little or no interest has been evoked in these ecdysones in this country.

Current Work at the University

Work is currently being carried out within the Chemistry Department at the University of Auckland in an attempt to utilise N.Z. natural products. We are particularly interested in using diterpenoid (C_{20}) compounds, one or two of which can be obtained in comparatively large amounts and in some cases by relatively simple techniques from our N.Z. conifers. We have four main objectives with our work which are summarised as follows:—

(i) Chemotaxonomic purposes.
(ii) Study of structural and stereochemical problems.
(iii) Preparation of optically active relays for synthesis.
(iv) Preparation of compounds with ambergris-type odours.

Most of our work connected with the first topic has been summarised elsewhere[14] while most of our published work over the last 4-5 years has been concerned with the second and third objectives. The preparation of compounds with ambergris-type odours is the subject of the remaining discussion.

Most current theories[15] concerned with the phenomenon of odour postulate a relationship between the type of odour and molecular structure, i.e. a change in the overall size and shape of a molecule results in a change of odour. From a consideration of the following compounds it appears that there

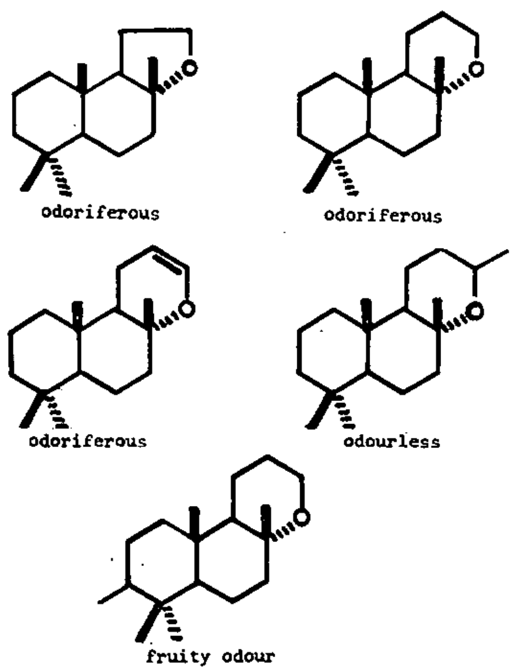
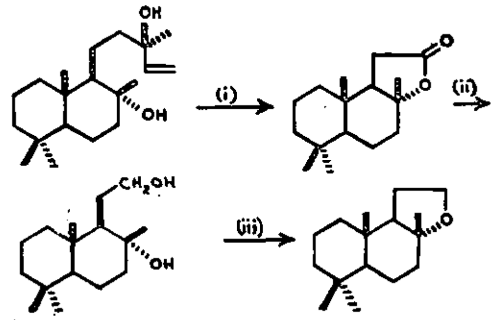


Fig. 4

is some correlation between the odoriferous properties of a molecule and the molecular geometry in close association with the osmophore (an osmophore is a functional group which imparts an odour to an otherwise odourless substance). For example, consider the 5-membered oxide above which has a strong ambergris-type odour. Enlarging the size of ring C to a 6-membered ring makes it a little less planar but provides no radical change in the geometry, and the second compound still has an ambergris-type odour. Likewise, introduction of unsaturation near to the ether linkage produces little change in the basic skeleton and thus produces no marked change in the odoriferous properties. However, introduction of a methyl group at C 13 alters the profile of the molecule in the region of the osmophore and results in the complete loss of the ambergris-type odour. Considering the distance between the osmophore and ring A it is not surprising that the introduction of a methyl group at C 3 does not have such a marked effect on the odour, and the derivative has a fruity odour.

Russian chemists[16] have shown that sclareol can be converted into the 5-membered oxide mentioned above by the following pathway.



(i) CrO_3/HOAc (ii) $LiAlH_4$ (iii) $MeC_6H_4SO_2Cl$/Py

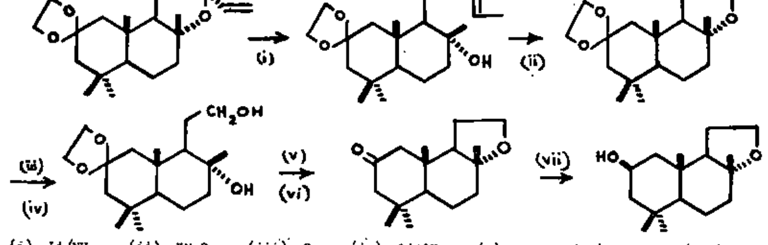
Fig. 5

Our initial aim has been to prepare oxygenated analogues of this odoriferous compound. Ketomanoyl oxide (10) from the New Zealand "silver pine" (*Dacrydium colensoi*) is a diterpenoid with an oxygen function at C 2, and it provides a convenient source material to effect the proposed transformations. From molecular geometry it would appear that there would be little or no change in the odour of 2-keto or 2-hydroxy analogues of the 5-membered oxide. However, since keto and hydroxy functions are polar groups and are not inert like alkyl groups, it was possible that they might have an unexpected effect on the odourant properties of the molecules.

After exploring a number of pathways we found that the route shown in diagram 6 was the most effective, giving yields of 23% and 17% of the ketone and alcohol, respectively[17].

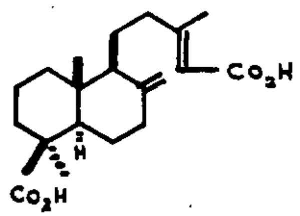
The ethylene acetal of 2-ketomanoyl oxide was subjected to hydrogenolysis with lithium in liquid ammonia. This afforded a quantitative yield of the ethylene acetal of 8α-hydrolabd-13-en-2-one. Oxidation with potassium permanganate followed by vacuum distillation gave the 2-ethylene acetal of an enol ether which on ozonolysis with reductive work-up gave the ethylene acetal of a diol. Hydrolysis and intramolecular dehydration with toluene-*p*-suphonyl chloride gave a 70% yield of the keto oxide in the penultimate step. Reduction with sodium borohydride afforded the 2-hydroxy derivative.

Although both the final ketone and the alcohol possessed ambergris-type odours, their odours were much weaker than that of the unsubstituted oxide itself. Also, the long-lasting properties of the odour of the unsubstituted oxide were not evident. Although this result was disappointing, in preparing the standard for comparison purposes we have been successful in effecting a two-step preparation of the 5-membered oxide from manoyl oxide (9). The 5-membered oxide has hitherto only been prepared from sclareol as detailed earlier. We have found that

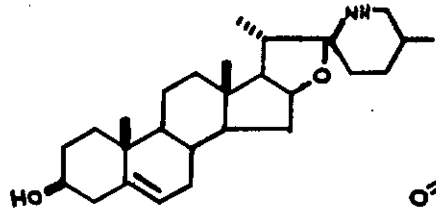


(i) Li/NH_3 (ii) $KMnO_4$ (iii) O_3 (iv) $LiAlH_4$ (v) HCl (vi) TsCl (vii) $NaBH_4$

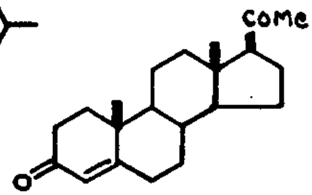
DIAGRAM 6



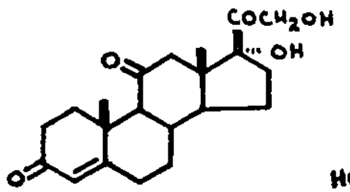
1



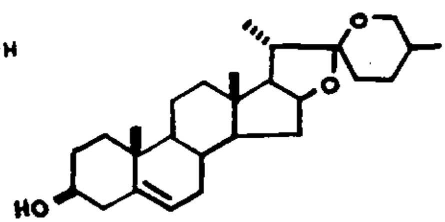
2



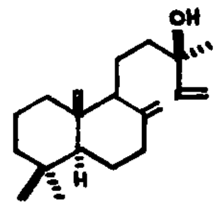
3



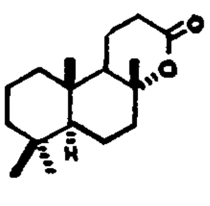
4



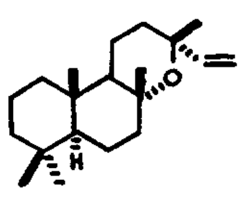
5



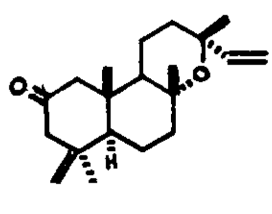
6



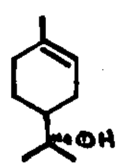
7



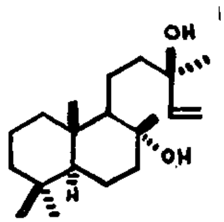
9



10



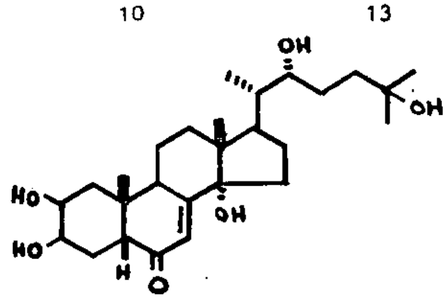
13



8

11

12



14

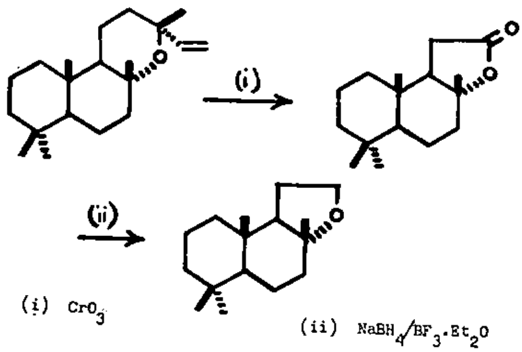


DIAGRAM 7

oxidation of manoyl oxide with chromium trioxide gives *inter alia* a γ-lactone which is the lower homologue of ambreinolide. Reduction of this lactone with diborane, prepared from sodium borohydride and boron trifluoride etherate, affords the desired compound (diagram 7).

It has also been shown that manoyl oxide (9) can be converted by the following route to an unsaturated lactone which is used by the Reynolds Tobacco Co. in the U.S.A. as

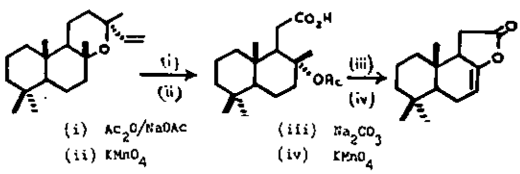


DIAGRAM 8

a tobacco-flavouring agent[18]. The final product is only produced in low yield and attempts are currently in progress to find a higher yield route to this compound. In connection with the perfumery work it is my opinion that it will be necessary to produce an odoriferous derivative on a semi-industrial scale before our raw materials such as manool, manoyl oxide, and ketomanoyl oxide are going to be of much value to New Zealand.

As with all research work, progress cannot be made without skilled workers to do it. I have been most fortunate in having some excellent research students working with me over the last few years and I pay a tribute to their skill and enthusiasm.

REFERENCES:

1. J. R. Hosking, *Rec. trav. chim.*, (1929), 48, 622.
2. L. J. Gough, *Chem. and Ind.*, (1964), 2059.
3. B. R. Thomas, *Acta chem. Scand.*, (1966), 20, 1074; "Organic Geochemistry" Springer-Verlag, (1969), pp. 599-618.
4. L. F. Fieser and M. Fieser, "Steroids", Reinhold Publishing Corp. (1959), p. 847.
5. L. H. Briggs, W. E. Harvey, R. H. Locker, W. A. McGillivray and R. N. Seelye, *J. chem. Soc.*, (1950), 3013.
6. K. Schreiber, G. Adam, O. Aurich, Ch. Horstmann, H. Ripperger and H. Ronsch, *Proc. 2nd Int. Congr. Hormonal Steroids, Milan*, (1966), 344; (*Chem. Abs.*, (1968), 68, Abs. 114803).
7. Y. Sato, N. Ikekawa and E. Mossetig, *J. org. Chem.*, (1959), 24, 893; (1960), 25, 783.
8. K. Schreiber and H. Ronsch, *Tetrahedron Letters*, (1963), 937.
9. Y. Sato, H. G. Latham, L. H. Briggs and R. N. Seelye, *J. Amer. chem. Soc.*, (1957), 79, 6089.
10. E. Demole, *Experimentia*, (1964), 20, 609.
11. "One Hundred Years of Chemical Research", D.S.I.R. Information Series, (1965), No. 46, p. 97.
12. S. G. Brooker and R. C. Cooper, "New Zealand Medicinal Plants" Handbook of the Auckland War Memorial Museum, (1961).
13. G. B. Russell and P. G. Fenemore, *N.Z. Jl. Sci.*, (1970), 13, 61.
14. R. C. Cambie and R. J. Weston, *Chemistry in N.Z., Jl. N.Z. Inst. Chem.*, (1968), 32, 105.
15. W. R. Roderick *J. Chem. Educ.*, (1966), 43, 510.
16. V. E. Sibirtseva, S. I. Virezub and S. D Kustova, *Pischchepromizdat*, (1961), 9 (*Chem. Abs.*, (1962), 57, 7316); V. E. Sibirtseva, A. S. Leshchiner and S. D. Kustova, *zhur. obshchei Khim.*, (1965), 35, 275 (*Chem. Abs.*, (1965), 62, 13184).
17. R. C. Cambie, K. N. Joblin and N. K. McCallum, *Aust. J. Chem.*, (1970), 23, 1439.
18. R. J. Reynolds Tobacco Co., French Pat. 1,346,170/1963 (*Chem. Abs.* (1964), 60, 14,475).

THE CHEMICAL FACETS OF ALUMINIUM PRODUCTION (THE ELECTRICAL PROCESS OF CONVERTING BAUXITE, THE ORE OF ALUMINIUM, INTO INGOT ALUMINIUM METAL)*

J. R. Hunt, A.A.A.C.I., M.Aust. I.M.M.

Comalco Industries Pty. Ltd.

The processing of bauxite is expensive. Costs are not likely to be reduced, but because of the favourable properties of the metal and its alloys the world wide usage is increasing.

The Ore

Bauxite is a loose pisolitic deposit normally found close to the surface in tropical areas. It is easily mined with large bucket conveyors. The overburden on these open cut mines varies from a few inches to a few feet.

Bauxite Treatment

The bauxite is crushed and then beneficiated, usually by washing at the site of the open cut mine, then screened. The final product is under three-quarters of an inch, but over ten mesh in fineness, and of sixty to sixty-five per cent aluminium ore content. For one lb. of aluminium we require 4 lbs. of bauxite, 4 lbs. of steam, 0.125 lb. of lime, 0.18 lb. of caustic soda, 0.016 lb. of starch, 0.02 lb. of soda ash. The starch and soda ash are used as a filter aid, soda ash combined with lime being used as a pre-coat for the final alumina precipitate prior to filtering. The lime is manufactured from crushed limestone and coke, pre-mixed and then kilned.

Inpurity Removal from Bauxite

The mix of bauxite and lime are accurately weighed on to a conveyor feed to a ball mill, standard conical type wet feed, and mixed with caustic soda return liquor (from filter) at 95 degrees centigrade. The product leaving the delivery end of the ball mill is screened, coarse material being fed back to the ball mill, the fine material passing through to keirs (autoclaves with agitators) where the aluminium oxide and aluminium sillicate are dissolved. Solid content of the feed to the keirs is 30% by weight and the flow rate is 630 gallons per minute. These keirs operate at up to 80 p.s.i. pressure. The screened material from the ball mill is minus 24 mesh. Additional hot caustic soda is added at this stage and the temperature is maintained at 165 degrees centigrade during the flow time through the keirs, which normally takes 45 minutes.

As the liquid plus solids leaves the keirs it passes through pressure flash coolers. The steam which is generated by this flash cooling is used to re-concentrate the caustic soda return liquor by special evaporator plant. The mix of solids and liquids then passes through a Dorr mud washer (a de-sanding section which is a Dorr bowl classifier removing the coarse silica which has not been dissolved), and then the mud is washed. The liquid then passes through two 60 ft. diameter Dorr-Oliver thickeners. At this stage lime and caustic soda and soda ash as a pre-coat to filtering are added. Starch is also added, if necessary, to coagulate any fine undissolved solid. The liquor is finally filtered through Kelly Leaf filters and the liquid, while still hot, passes through vacuum flash cooling units where the temperature of the liquid is dropped to 80 degrees centigrade.

Aluminium Oxide Production

At the Bell Bay Tasmania plant the liquid is then pumped into 24 tanks, each 100,000

---

* Paper presented at NZIC Conference, Dunedin, 1969.

gallon capacity, and the liquor is seeded with pure crystalline aluminium oxide and allowed to settle for 30 hours. During this period the liquor in the tanks is agitated with air, which assists the right chemical conditions for maximum precipitation of aluminium oxide from the liquid. The crystals are then filtered on a rotary drum vacuum filter and hot-washed with condensate water.

The crystals, aluminium oxide, then pass into oil-fired Pfeiffer rotary kilns. At Bell Bay there are two of these, 165 feet long, 8 feet in diameter, which dry this hydrate, which contains 12% moisture, at 250 degrees. Further on through the kiln the aluminium oxide crystals are calcined at 1200 degrees centigrade which gives a dry, white, anhydrous aluminium oxide Al_2O_3. Dust from the flue gases is collected in a multi-cyclone dust collector, then through electrostatic precipitators.

The major waste product of this process is the red mud, mainly iron oxide, which also contains 3 grammes per litre maximum of sodium hydroxide.

Control Methods

Chemical control methods relate to sampling all of the raw material preparation of samples for subsequent analysis, either by wet chemical analysis or instrumental and automatic analysis. Control checks during processing are used to detect alterations in the process. Analysis and identification of final products is the responsibility of the laboratory section, as well as the analysis and pilot plant tests on all new ore deposits and exploration samples.

The heat costs and sodium hydroxide loss through sodium silicate are the most important cost factors in alumina production. The calcined alumina is transported into silos near the furnace potlines, then pipe-fed to the top of each reduction furnace.

Furnaces or Cells or Pots

The furnaces used for aluminium production from aluminium oxide consist of a large number of small pots about 7 ft. wide, 15 ft. long and 2 ft. deep. The internal lining of these furnaces is baked carbon which acts as part of the cathode system, the anode being twenty individual 500 lb blocks per cell, which are lowered into the surface of the molten flux.

The furnaces are electrically in series, the electric power from the anode passing through the flux and metal to the cathode, through busbar to the next anode, through the flux to the molten aluminium to the cathode, then by busbar to the next furnace.

The chemicals used in the furnace itself consist of cryolite, either natural or manufactured synthetically from fluosilicic acid, which is converted to sodium silico-fluoride. This is a white powder which when reacted with sodium carbonate gives sodium fluoride. This is reacted with sodium aluminate, giving the synthetic cryolite.

To manufacture a pound of aluminium 2 lb. of alumina, 0.02 lb. of cryolite, 0.03 lb. of aluminium fluoride, 0.4 lb. of coke, 0.2 lb. of coal tar pitch and 7½ kilowatt hours of electricity are required.

Electric Power Conversion

Voltage of the cell or each pot is averaged at 4.65 volts. This voltage can be varied by adjusting the distance between the anodes and cathodes, but the amps in the line are held constant. The line current for the more modern pots can range up to 100,000 amps. In Bell Bay it is 86,000 amps. Kilowatts per cell average 400. An average production of 1350 lbs. of aluminium per cell per day is obtained. Thus each pound of aluminium uses 7½ Kilowatt hours; one short ton uses 15.000. Much of the power used is converted into heat energy.

The actual life of the pot furnace is about 2½ years, but the life of the anode itself is about ten days. Dependent on raw materials, the aluminium produced is 99.8% pure; impurities are iron (0.14%) and silicon (0.06%).

The temparture of the metal in the pot or cell is 980 degrees centigrade. The molten cryolite, 7 to 8 inches deep, floats on top of the molten aluminium and the anode is adjusted at about 5 inches from the top of the cryolite surface so that it is 2 inches from the cathode (which is then the molten aluminium). The reaction of the electric power in this gap of two inches, converts the dissolved alumina in the cryolite aluminium fluoride mix into aluminium plus oxygen. The oxygen reacts with the carbon of the anode to form carbon dioxide. The maximum amount of aluminium oxide which can be dissolved in the cryolite flux is about 6%, but if the amount of dissolved alumina drops to 1%, then the voltage of the cell starts to rise. Before it reaches 30 volts, due to the formation of fluorine gas on that anode the crust is broken and more aluminium oxide feeds into the surface. When casting, the metal is tapped off until about 7 inches of molten aluminium is left in the bottom to continue as the cathode and also to keep the flux molten.

Carbon Products Manufacture

The carbon plant, which is an ancillary to the reduction smelter, consists of a crushing area, kiln drying area and a ball mill, a pitch melter and a mixer.

To make the anodes, petroleum coke low in impurities is crushed, dried, ball milled to a fineness of 50% and minus 200 mesh, then mixed with a controlled melting coal tar pitch. Then it is pressed into the anode shape, baked at high temperature, about 1200 degrees centigrade, and the air is excluded from the furnace by sealing the whole of the pit furnace off with fine coke. The anodes are subsequently rodded, that is, cast iron rods are set into the holes in the top of the anode block; molten cast iron from a high frequency reduction furnace is cast around these rods and then copper rods are threaded into the cast iron to act as the conductor of electricity.

To form the cathode, steel bars are used to conduct the current from the busbar. These are protected from the molten aluminium by a very thick rammed mix of carbon paste, which is subsequently dried for four days in the furnace. This particular paste is made from anthracite coal, which is dried and milled to 30% minus 200 mesh, mixed with the similar melting point pitch. The anode paste which is used to form the anode contains normally about 20% coal tar pitch and 80% crushed petroleum coke. The cathode paste contains only 15% coal tar pitch and 85% crushed anthracite coal.

The unwanted impurities in all raw materials used in the manufacture of aluminium are iron, silicon, titanium, manganese, chromium, vandium and zirconium.

Carbon plant output at Bell Bay is 15 tons per hour.

Casting Metal and Alloys into Shape

To convert the molten metal into usable products the metal (which has been pre-analysed by the spectrograph twice) from each pot, is blended with other metal from other pots in a furnace, to suit the specifications required. The process is now done by computer; the results of both analyses are fed direct from the spectrograph to the computer at the same time as the programme for the 24 hours schedule is fed to the computer. It automatically specifies which pots should be grouped together, and into which furnace they should be poured, to make sure that the day's production of quantity and specification quality is achieved.

The metal from these furnaces is cast into a suitable remelt form, or a form suitable for subsequent fabrication by rolling, extrusion, forging or wire drawing. The final control analysis of the metal is made at this stage, and the specification certificate is endorsed, based on the final analyses made during this casting. Thus products are released firstly on chemical testing, secondly on physical surface and dimension inspection, and thirdly on an ultrasonic inspection to ensure that the products as cast are sound.

Some of the products require further heat treatment to ensure the maximum degree of subsequent workability. The control of this processing and subsequent checks are the responsibility of both the production and the laboratory staff.

OBITUARY

John Packer, M.Sc. (Melb.) D.I.C., Hon.D.Sc. (Cant.) F.R.I.C., F.N.Z.I.C., F.R.S.N.Z., Professor of Chemistry University of Canterbury, 1944-64

John Packer was a product of D. Orme Masson's school at the University of Melbourne, of which it was said by the late Sir Thomas Easterfield (1909) that "with the exception of Orme Masson, none of us (in the Antipodes) has succeeded in forming a recognised research school".

Packer came to New Zealand as a consequence of the appointment (1923) of H. G. Denham to succeed W. P. Evans in the chair of chemistry at Canterbury University College. On his way from Capetown to Christchurch, Denham, having previously written to Masson of his need for a lecturer in organic chemistry, interviewed Masson's nominee (dressed in motor-cycle overalls) and recommended his appointment. Packer was not specifically an organic chemist. He had worked on heterogeneous equilibria with a master in that field (A. C. D. Rivett), and was in 1922 a research chemist in low temperature coal carbonisation. At Canterbury College however, he took over organic chemistry and the first year laboratory, and began an association with science and education in New Zealand which was interrupted only by his sudden death last February—forty-eight years of distinguished and devoted service to which many people will have reason to pay personal tribute.

In 1926 Packer had a year's leave to study in J. F. Thorpe's research school at Imperial College. He went with the possibility that it might be extended to two years, but in the event, Professor Denham had to ask him to return after one year. It was however a seminal year for him. Thorpe had been involved for many years with some problems in the prototype of the glutaconic acids and their esters, and had formulated them in terms of a "semi-aromatic" formula which, although no longer acceptable, did direct attention to important effects on stability relations of geometrical isomerides. Packer's work at Imperial College and later work at Canterbury, notably with T. H. McCombs, was important in clarifying the picture, though it was later work of G. A. R. Kon which put the problem in sound theoretical perspective. It was from this experience that Packer's life long interest in organic reaction mechanism stemmed. He began introducing the ideas of Sir Robert Robinson and especially of C. K. Ingold (also one of Thorpe's school) in to his teaching very early, despite the handicap of overseas external examinations which dogged university teaching in New Zealand till World War II put an end to it. Another decisive event was the appointment of John Vaughan to the Canterbury staff. Vaughan brought a boundless enthusiasm for reaction mechanisms, which played a large role in inducing Packer to embark on writing a textbook. "A Modern Approach to Organic Chemistry" by Packer and Vaughan (1958) was described by Ingold in a foreword as blazing "a trail in the written presentation of organic chemistry". Moreover Ingold's view that "to write such a book required a pioneering spirit, and the patience and willingness to reconsider and revise, to the limit of immediately feasible improvement, exactly as in any other form of original work", was fully justified. Delays in publication allowed other writers with similar aims to catch up and the credit which the authors received was less than they deserved. Well before this however, Packer had succeeded H. G. Denham in the chair of chemistry (1944) and had begun his long association (1943-61) with the Academic Board of the University of New Zealand. This was the period of the final (and successful) reform movement in the university, which culminated in the demise of the federal university system. Packer was a doughty fighter in the cause of "defederalisation".

He served on the University Senate for the last eight years (1954-61) of its existence, and on its Curriculum Committee over the difficult years of "devolution of powers" from the federal university to the constituent colleges. He built up an extensive knowledge of the complexities of academic administration in such a period, which was of enormous value to his colleagues. He was deputy chairman of the Canterbury Professorial Board, one of its representatives on the Lincoln College Professorial Board, and a member of the C.U. Council during most of his last years in office.

On his retirement in 1964 he was appointed Professor Emeritus and was immediately in demand by the University Grants Committee and the Department of Education as an assessor for research grants and for the equipping of new buildings, and this work continued right up to his death, maintaining his wide contacts with science departments throughout the country.

Professor Packer was a foundation Fellow of the Institute (Associate 1931, Fellow 1934, Honorary Fellow 1935) and a Fellow also of the Royal Institute of Chemistry and the Royal Society of New Zealand. In the Institute he was Canterbury Chairman in 1936 and National President in 1949. In 1962 he was President of Section B of A.N.Z.A.A.S.

John Packer's achievement in the university, which was his life, was an all round one. Teaching and research are, or should be, a seamless web in a university. Packer's teaching illustrated principles which are eternal at the university level; his pupils became familiar with orthodoxy, what the followers of Thomas Kuhn call "normal science"; but they, or the better of them, learned to go the next step, of questioning orthodoxy, of what Sir Eric Ashby calls disciplined dissent. The Packer-Vaughan text was written in that spirit—of not being afraid to speculate, to be proved wrong, or even (heinous crime to some minds) to be somewhat less than "up to date" (as if the current wisdom is final).

His administrative contributions were wide and varied and made in a spirit of service. He was a man of generous mind, delighted in the progress and success of others, modest of his own achievements. His contribution to his adopted country and to the university system he worked in was a great one. The University of Canterbury recognised it, when in 1962, having gained the right to award its own degrees, it bestowed on him its academic accolade, the degree of D.Sc. (honoris causa). Nothing could have been more appropriate.

His passing leaves only A. D. Monro, of the university chemistry teachers of the twenties still with us. The Packer name however remains. John Packer's son, Dr. J. E. Packer, carries on the chemical tradition as a senior lecturer at Auckland University.

—H.N.P.

1971 SALARY SURVEY

P. K. Foster, M.Sc., Ph.D., D.I.C., F.N.Z.I.C. and J. H. Darwin, M.Sc., B.A. (Cantab.), Ph.D. (Manch.)

This report summarises data collected in the 1971 survey, in which salaries as at March-April were surveyed. For comparison, the information was requested and analysed in the same way as in May, 1969, except that Branch location was also considered.

No detailed discussion is entered into here. The preparation of the tables was all that could be achieved before the deadline for the current issue of the Journal.

The following should be noted:-

1. With the exception of Table I, each table can be compared directly with the table of the same number in the 1969 Survey.

   Table I here gives information so that "t" values can be converted to significance levels. See tables 7-9.

2. The general remarks of the 1969 survey apply equally here.

3. 594 returns were received in a condition which was sufficiently unequivocal for inclusion, after student and retired members had been sifted out. The detailed analysis of variance on the restricted groups (see 1969 survey) was carried out on 544 returns and yielded an R^2 of 57 per cent. "Location" was not significant, and so was omitted from the analysis.

   As in 1969 the employment group was non-significant (see Table 8).

4. The ratios of the means from the 1971 and 1969 surveys for the five major employment groups give the following estimates of total movements (cost-of-living and promotion) in the last two years:-

Employment Group	% increase
School teaching	28.9
Industry	17.9
Government	34.9
University	21.8
R.A.	35.5

A rigorous statistical test for differences has not been possible with the data available. The reader's attention is drawn both to the large standard deviation of $1,330 for the analysis of Table 6, and to the fact that the above figures make no allowance for those factors which the analysis shows to be significant. Caution should therefore be used in interpreting the above figures at this stage. If a suitable statistical test can be developed, results and comments will be included in the next issue of the Journal.

Acknowledgements: The authors are grateful to Staff of the Chemistry Division, D.S.I.R., for assistance in data collection and reduction.

TABLE 1

Value of "t"	Significance level (%)
0.25	80
0.67	50
1.28	20
1.65	10
1.96	5
2.33	2
2.57	1
3.29	0.1

Corresponding values of "t" and significance levels for comparison of differences.

Table 2 — AGE GROUP-EMPLOYMENT GROUP COMBINATIONS

Age Group	*School Teaching*	*Industry*	*Govern-ment*	*University*	*Res. Assns.*	*Self-employed*	*Tech. Institutes*	*Others*
<25								
No.	1	9	5	6	1	—	—	4
Mean	4,255	4,186	3,670	3,267	3,996	—	—	3,595
S.D.	—	865	257	640	—	—	—	359
26-30								
No.	9	43	16	23	11	—	3	2
Mean	4,553	5,398	4,934	4,937	5,178	—	5,173	5,100
S.D.	428	1,105	869	945	598	—	170	140
31-35								
No.	4	30	15	25	11	2	5	3
Mean	5,801	6,149	5,662	6,076	5,722	8,250	5,705	5,291
S.D.	209	1,586	865	961	880	5,303	1,209	869
36-40								
No.	14	24	11	23	4	2	2	2
Mean	5,784	7,105	6,677	7,195	5,804	4,900	6,581	6,514
S.D.	861	2,575	1,263	1,228	693	1,555	257	2,737
41-45								
No.	5	41	25	18	7	—	5	4
Mean	6,583	7,075	7,417	7,693	8,646	—	6,022	6,371
S.D.	1,584	2,077	1,402	1,876	1,473	—	522	1,132
46-50								
No.	4	31	23	12	2	1	—	2
Mean	7,402	7,233	7,754	8,357	8,740	6,500	—	7,418
S.D.	1,506	1,682	1,237	1,980	432	—	—	399
51-55								
No.	4	14	14	10	2	—	1	1
Mean	6,270	7,516	8,058	8,650	9,522	—	6,942	5,219
S.D.	654	3,624	1,977	2,002	675	—	—	—
56-60								
No.	1	10	19	2	2	2	—	1
Mean	5,753	7,996	8,112	9,500	6,147	7,750	—	6,425
S.D.	—	2,781	1,654	2,121	1,173	4,596	—	—
61-65								
No.	—	4	6	4	1	—	—	1
Mean	—	7,500	6,870	10,100	6,600	—	—	8,600
S.D.	—	1,080	1,381	2,232	—	—	—	—
>65								
No.	1	—	—	—	—	1	—	3
Mean	9,739	—	—	—	—	7,000	—	5,764
S.D.	—	—	—	—	—	—	—	3,055

Table 3 — AGE GROUP-PRIMARY QUALIFICATION COMBINATIONS

	Primary Qualification				
Group	*3 yr. B.Sc.*	*4 yr. B.Sc. or M.Sc.*			
Age	*or ANZIC*	*Pass*	*3rd Class*	*2nd Class*	1st Class
<25					
No.	3	5	2	14	2
Mean	3,550	3,935	3,423	3,827	3,755
S.D.	397	316	115	912	339
26-30					
No.	18	24	5	36	24
Mean	5,064	5,005	5,045	5,090	5,356
S.D.	869	1,259	701	854	845
31-35					
No.	20	16	5	37	17
Mean	5,181	6,039	5,026	6,245	6,530
S.D.	949	1,188	1,418	1,500	922
36-40					
No.	27	12	4	19	20
Mean	6,274	6,673	6,432	6,789	7,271
S.D.	2,308	1,825	1,385	1,385	1,184
41-45					
No.	35	13	12	26	19
Mean	7,028	6,419	7,029	7,469	8,160
S.D.	2,190	1,791	1,121	1,432	1,573
46-50					
No.	30	9	11	17	8
Mean	7,231	7,259	7,458	8,128	8,597
S.D.	1,736	1,359	1,054	1,479	1,607
51-55					
No.	9	8	7	14	8
Mean	6,794	7,991	7,344	8,218	8,659
S.D.	1,893	4,506	1,776	2,049	1,991
56-60					
No.	5	6	1	17	8
Mean	7,760	7,216	7,000	7,338	9,903
S.D.	2,367	780	—	1,804	2,567
60-65					
No.	3	3	2	5	3
Mean	6,559	7,111	7,717	7,475	11,000
S.D.	1,611	1,261	1,013	942	1,802
>65					
No.	1	1	—	1	2
Mean	4,000	4,000	—	9,739	8,146
S.D.	—	—	—	—	1,620

Table 4 — PRIMARY QUALIFICATION-EMPLOYMENT GROUP COMBINATIONS

	School Teaching	Industry	Government	University	Res. Assns.	Self-employed	Tech. Institutes	Others
3 yr. B.Sc. or ANZIC								
No.	10	87	26	9	7	3	3	6
Mean	5,778	6,473	6,407	6,739	6,281	7,833	6,117	4,562
S.D.	1,753	2,180	1,654	2,189	1,710	2,754	491	959
4 yr. B.Sc. 4 yr. M.Sc. Pass								
No.	13	47	20	5	3	1	2	6
Mean	5,521	6,395	6,754	4,476	6,406	3,800	6,614	5,301
S.D.	968	2,527	1,270	1,056	2,624	—	978	1,706
4 yr. B.Sc. 4 yr. M.Sc. 3rd Class								
No.	7	21	14	3	—	—	2	2
Mean	6,632	6,476	7,423	5,400	—	—	4,788	5,977
S.D.	1,098	1,214	1,832	1,571	—	—	764	3,497
4 yr. B.Sc. 4 yr. M.Sc. 2nd Class								
No.	12	43	48	48	18	3	8	6
Mean	5,805	6,622	6,896	6,591	5,959	7,000	5,988	6,371
S.D.	1,425	1,776	1,996	2,053	1,637	4,330	821	1,492
4 yr. B.Sc. 4 yr. M.Sc. 1st Class								
No.	1	8	26	58	13	1	1	3
Mean	6,866	8,731	7,347	7,234	7,124	7,000	5,200	7,326
S.D.	—	2,980	1,901	2,098	1,708	—	—	1,899

Table 5 (a) — MAJOR FUNCTION-EMPLOYMENT GROUP COMBINATIONS

Group	*Teaching*	*Industry*	*Govern-ment*	*University*	*Res. Assns.*	*Self-employed*	*Tech. Industries*	*Others*
Research								
No.	—	7	73	23	30	—	—	6
Mean	—	6,172	6,828	5,024	6,218	—	—	6,236
S.D.	—	816	1,796	1,771	1,585	—	—	2,045
Teaching								
No.	34	—	—	85	—	—	15	1
Mean	5,438	—	—	6,774	—	—	5,796	6,425
S.D.	913	—	—	1,581	—	—	792	—
Development								
No.	1	34	6	—	2	1	—	1
Mean	7,414	5,262	7,241	—	6,162	7,000	—	5,200
S.D.	—	1,188	2,083	—	795	—	—	—
Admin./Mgt. —Laboratory								
No.	1	68	18	7	5	—	1	4
Mean	9,400	6,406	8,018	9,826	8,460	—	7,306	5,941
S.D.	—	1,433	1,484	2,527	2,308	—	—	1,049
Admin./Mtg. —Other								
No.	7	57	11	6	1	2	—	4
Mean	7,255	8,373	7,941	10,097	5,000	4,900	—	6,100
S.D.	1,478	2,754	2,001	1,259	—	1,555	—	2,395
Sales and Service								
No.	—	11	—	1	—	2	—	1
Mean	—	5,612	—	10,000	—	9,250	—	8,450
S.D.	—	1,117	—	—	—	3,889	—	—
Analysis and Testing								
No.	—	10	26	1	3	1	—	6
Mean	—	4,800	5,924	4,500	5,631	4,500	—	4,280
S.D.	—	972	1,333	—	856	—	—	977
Process/Quality								
Control	—	17	—	—	—	—	—	—
No.	—	5,530	—	—	—	—	—	—
Mean	—	913	—	—	—	—	—	—
S.D.								
Consulting								
No.	—	2	—	—	—	2	—	—
Mean	—	7,750	—	—	—	7,750	—	—
S.D.	—	3,181	—	—	—	4,596	—	—

Table 6 — CORRELATION FROM ANALYSIS OF VARIANCE STUDY OF RESTRICTED GROUPS (N = 544)

Basic Salary in Dollars	*Age Group Correction*				
6918	<25	—2,213	3 yr. B.Sc. or ANZIC		—322
	26-30	—1,445			
	31-35	— 887	4 yr. B.Sc. or M.Sc.	Pass	—160
	36-40	+ 44	4 yr. B.Sc. or M.Sc.	3rd Class	—207
	41-45	+ 478	4 yr. B.Sc. or M.Sc.	2nd Class	+136
	46-50	+ 943	4 yr. B.Sc. or M.Sc.	1st Class	+552
	51-55	+1,176			
	56-60	+ 929			
	61-65	+ 974			

For "t" levels of differences within group— see Table 7

Doctoral Qualification Group Correction		*Employment Group Correction*		*Major Function Group Correction*	
Without	—669	School Teaching	+ 5	Research	— 463
With	+669	Industry	—27	Teaching	— 589
		Government	+120	Development	— 186
		University	—110	Administration Management—	
		Research Assns.	+ 11	Laboratory	+ 509
				„ Other	+1,803
				Sales and Service	+ 163
				Analysis and Testing	— 928
				Process or Quality Control	— 310

For "t" levels of differences within group— see Table 8 see Table 9

Table 7

Mean Salary Correction (from Table 6)	*Qualification Group*	*"t" levels of differences between qualification groups*			
		3 yr. B.Sc. or ANZIC	4 yr. B.Sc. or M.Sc. Pass	4 yr. B.Sc. or M.Sc. 3rd Class	4 yr. B.Sc. or M.Sc. 2nd Class
—322	3 yr. B.Sc. or ANZIC				
—159	4 yr. B.Sc. or M.Sc. Pass	0.86			
—207	4 yr. B.Sc. or M.Sc. 3rd Class	0.49	0.19		
+136	4 yr. B.Sc. or M.Sc. 2nd Class	2.57	1.55	1.42	
+552	4 yr. B.Sc. or M.Sc. 1st Class	4.04	3.14	2.80	2.37

Table 8

Mean Salary Correction (from Table 6)	*Employment Group*	*"t" levels of differences between employment groups*			
+ 5	School Teaching	School Teaching	Industry	Government	University
— 27	Industry	0.10			
+120	Government	0.35	0.72		
—110	University	0.41	0.32	0.95	
+ 11	Research Assns.	0.01	0.14	0.45	0.41

Table 9

Correction Mean Salary (from Table 6)	*Major Function Group*	*"t" levels of differences between Major Function Groups*						
— 463	Research	Research	Teaching	Develop-ment	Admin./ Mtg.- Lab'tory	Admin./ Mgt.- Other	Sales and Service	Anal. and Testing
— 589	Teaching	0.48						
— 185	Development	1.03	1.20					
+ 509	Admin./Mgt. Laboratory	4.49	3.82	2.77				
+1,803	Admin./Mgt. Other	9.77	8.36	7.64	6.38			
+ 163	Sales and Service	1.44	1.62	0.79	0.84	3.92		
— 926	Analysis and Testing	1.82	0.98	2.34	5.33	9.74	2.35	
— 310	Process/Quality Control	0.40	0.65	0.32	2.30	5.85	0.93	1.49

REMINDER

Subscriptions were due on May 1, 1971.

Fellows and Associates 8.00 dollars

Graduate Members

Exemption from subscriptions at age 65 years or on retirement at not younger than 60 years is available on application to Council.

Would the person who advertised a Unicam Spectrophotometer for sale in the last issue of the Journal please contact the Editor as soon as possible.

MEMBERSHIP OF THE INSTITUTE BY EXAMINATION

(from the Auckland Branch Committee)

The Committee of the Auckland Branch of the Institute have recently considered the question of entry to Associateship or Graduate Member of N.Z.I.C. by examination. It is our unanimous opinion that the status quo should be maintained, and that entry by examination should continue to be available to those who wish to take advantage of it.

This matter is being discussed by several branches at the present time, and Council may soon take a decision on whether entry by examination should continue or be abolished. In order to inform members of the Institute on this question, we have set out below some of our reasons for wishing the examination route to A.N.Z.I.C. to be retained.

1. The principal means of entry to N.Z.I.C. is the Bachelor's degree, with Chemistry III or its equivalent included (rule 9.2.1). In some cases equivalent qualifications (rule 9.2.2.) or membership of the Chemical Institutes in Britain, Australia, Canada or South Africa (rule 9.2.3) may be used. A small number of persons have gained entry through rule 9.3 which applies to those whose knowledge, training and experience are fully equivalent to the required standard of attainment. But rule 9.3 is normally used by senior people above the age of about 35 who have had time to demonstrate their knowledge and experience by a successful record of employment in the profession. Junior people under about 35 (non-graduates) will not normally have had the chance to establish themselves sufficiently well to satisfy rule 9.3.

2. There are a number of candidates for A.N.Z.I.C. (about one per year) who have not attempted a University degree, because their career was planned with other objectives in mind, such as the N.Z.C.S. (Chem.) qualification. These people may wish to become Associates of the Institute in order to help their careers, but they cannot afford to wait until they have accummulated enough experience to qualify under rule 9.3. For these people a special examination is laid down in the Regulations (rule 9.2.4), and candidates who pass the examination and have the necessary practical experience can be admitted to full membership of N.Z.I.C. The examination method of entry encourages further study by people who otherwise would be turned away from the Institute.

3. This examination route to membership (rule 9.2.4) has worked well in the past, and the Institute has gained some excellent members in this way. The Auckland Branch has been fortunate to gain several first class members through the examination route, and we feel strongly that this rule (9.2.4) has proved its worth and must not be discarded.

4. The examination route to membership (rule 9.2.4) is administered by the Examinations Committee who have maintained a satisfactorily high standard, and who are well aware of the need to preserve the professional standing of the Institute. At present the Regulations specify that a candidate should pass the Chemistry III theoretical and practical examination at a New Zealand university. This requires suitable background studies (N.Z.C.S. plus Chemistry II) as well as a full year's work on the Chemistry III course itself. The standard attained is in no way inferior to a B.Sc., if one realises that the candidate usually has N.Z.C.S. and practical experience before beginning Chemistry III.

5. The first objective of the Institute is (rule 3.1) "to promote the science and

practice of chemistry in all its branches and the usefulness and efficiency of persons engaged therein". On the New Zealand scene this objective can only be realised by admitting *all* those worthy of making a significant contribution, and this includes candidates whose only chance of membership is by the examination route. The Institute has still a long way to go before all qualified chemists in New Zealand are members, and it would not be wise to abandon one of the routes to membership at this stage.

6. Unlike some other professions (Law, Medicine, Architecture, Engineering) a chemist is not required to become *registered* and subject to control by Act of Parliament. Hence it is unnecessary to have one single, legally defined criterion of membership (Bachelor degree). Chemists serve the community in a great variety of ways (research, development, administration, management, production, quality control, testing, analysis, consultancy, etc.) and hence the Institute does not require the same rigidity of qualifications that may be desirable in some other professions.

7. Equality with sister institutes overseas is not essential, because New Zealand conditions are not exactly the same as elsewhere, and the task of the Institute is to serve the interests of New Zealand chemists. The large, industrialised countries can afford to have a more restricted membership (degree only) because there is more specialisation in these countries—they can segregate chemists from biochemists, chemical engineers and chemical technicians, and still have large memberships of the respective institutes. But in New Zealand our industry and technology is in a relatively early stage of development. Consequently the Institute should be a little more flexible and wider in membership than in the larger industrial countries.

8. It might be argued that continuance of the examination route to membership of N.Z.I.C., would mean that students who failed their B.Sc. but managed to pass Chemistry III would be eligible for admission, hence weakening the academic level of the Institute. But it must be pointed out that the Universities lay down pre-requisites for the Chemistry III course (usually 6 units passed, including Chemistry I and II) and this means that the candidate would have 7 units if he was successful in Chemistry III. This is almost equivalent to a full degree qualification (8 units), and in any case A.N.Z.I.C. is a *professional* qualification (requiring experience in the practice of chemistry) and not a purely *academic* qualification.

9. If the Institute is to exercise some degree of leadership and control of the profession in New Zealand, its members must include all those who are genuine practitioners of chemistry. Only by continuing with the examination route, can membership be made available to the small, but important, group of people who are without a degree, but who are still too young to qualify under the "experience" rule 9.3.

ELECTROCHEMISTRY GROUP

The Electrochemistry Group will sponsor a series of specialist sessions on various aspects of Electrochemistry during the Annual Conference of the Institute at Hamilton, 23-26 August, 1971. Members of the Electrochemistry Group or any others interested in any aspect of Electrochemistry are invited to present papers at this Conference. Please send your proposed title and abstract (200 words) to the Secretary as soon as possible.

Secretary: G. A. WRIGHT,
Department of Chemistry,
University of Auckland,
Private Bag, Auckland.

REPORT ON AUCKLAND ATOMIC ABSORPTION SYMPOSIUM

The Auckland Branch held on 26 and 27 April the first symposium in New Zealand on atomic absorption spectroscopy. The symposium had a bias towards practical techniques and applications and was aimed at the large number of industrial chemists in the Auckland area. An invitation was extended to chemists in other centres and altogether over 60 attended. Farthest afield were those from Westland and Nelson. Biochemists and technicians from medical laboratories and other non-Institute members also participated.

One feature of the symposium was the participation of several local firms. These firms, Geo. W. Wilton, Smith Biolab and Thomas Hyde took an active part in the symposium rather than just providing a static display. It was felt that chemists contemplating the purchase of AA equipment would appreciate seeing the instruments being operated, and the idea received favourable comment. N.Z. Industrial Gases provided cylinders of air and acetylene.

The programme provided a balance between general papers and those giving details of actual techniques. Historically, it moved from the early work of Walsh to the latest techniques of the carbon rod furnace.

The full list of speakers and titles was:—

J. E. Allan, Ruakura Research Station, "Historical Introduction".

H. Green, A.I.D.D. (D.S.I.R.), Auckland, "The analysis of ferrous metals using atomic absorption spectroscopy".

R. Goguel, Chem. Div. (D.S.I.R.), Lower Hutt, "The choice of flames, with comments on burners".

G. McSweeney, N.Z. Fert. Man. Res. Assn., Auckland, "Experience with AA at NZ FMRA".

J. E. Allan, Ruakura Research Station, "Interferences".

J. Johannesson, Auck. Tech. Inst., Auckland, and D. McDonald, N.Z. Forest Products, Kinleith, combined to give a lecture and demonstration on "Analyses for mercury using flameless atomic absorption".

I. Devereux, Rocklabs, Auckland, "The analysis of geological materials using atomic absorption spectroscopy".

W. Hayward, Alcan, Auckland, "The use of atomic absorption in the analysis of aluminium and its alloys".

J. Aggett, Chem. Dept., Auckland University, "Atomic Fluorescence".

P. Wheeler, N.Z. Forest Products, Auckland, "Applications of atomic absorption spectroscopy at N.Z. Forest Products Ltd.".

P. Bennett, Varian Techtron, Melbourne, "The development of a graphite microfurnace for atomic absorption" and "The Varian Techtron carbon rod atomiser".

The lecture and demonstration by Peter Bennett gave New Zealand chemists a look at some of the very recent developments in atomic absorption. The new carbon filament technique enables analysis, down to ppm level, of only one microlitre or less of solution.

On the evening of 26 April the symposium combined with the monthly meeting of the Auckland Branch to hear a lecture "The analysis of agricultural materials by atomic absorption spectroscopy" by J. E. Allan. This lecture and the two given in the symposium enabled all those present to appreciate the very substantial contribution J. E. Allan has made to the technique of atomic absortion spectroscopy. His work is known throughout the world, probably better known in many places overseas than in New Zealand.

The symposium concluded with an open forum giving everyone the chance to speak, make suggestions and seek assistance on their own specific problems. This proved an excellent way to round off two full days of papers and discussion on a topic very much of interest to chemists in New Zealand today.

—Ian Devereux

IUPAC NEWS

TECHNICAL REPORTS

(Appendices to IUPAC Information Bulletin)

Following the excellent appreciation with which *Appendices on Tentative Nomenclature, Symbols, Units and Standards* (Yellow Booklets) have been received by the chemistry community throughout the world after the series was launched in December, 1969, the Committee on Publications of IUPAC recommended that appropriate technical reports from the Sections and Commissions should be used in a second series of Appendices to the *Information Bulletin*.

The first three *Technical Reports* (Blue Booklets) in the new series will be published shortly:

1. Collaborative Study of a method for determination of concentration and purity of aflatoxin standards and use of the method for measuring stability of the standards.
2. Minimum specifications for seven extraction solvents used in food processing.
3. World wide survey of fermentation industries, 1967.

Gratis copies may be obtained by writing to the IUPAC Secretariat, Bank Court Chambers, 2-3 Pound Way, Cowley Centre, Oxford OX4 3YF, U.K.

N.Z. SCIENCE CONGRESS

The 12th New Zealand Science Congress will be held at Massey University, Palmerston North, January 31-February 4, 1972.

Institute of Chemistry members of the Manawatu Branch who are assisting in the organisation of this congress include Dr. R. Brookes, Dr. R. Bailey and Mr. R. M. Greenwood.

FORTHCOMING INTERNATIONAL CHEMICAL SYMPOSIA

1. Second International Conference on Calorimetry and Thermodynamics—Orono, Maine, U.S.A.—12-14 July, 1971.
2. Fourth International Symposium on Magnetic Resonance—Rehotov, Israel —24-31 August, 1971.
3. Eighth and Ninth Prague IUPAC Microsymposia on Macromolecules—Prague, Czechoslovakia—30 August-9 September, 1971.
4. First International Symposium on Advances in Microbial Engineering—Marienbad, Czechoslovakia—6-10 September, 1971.
5. Third National Conference an Analytical Chemistry—Brasov, Romania—22-26 September, 1971.
6. Eighth International Symposium on Chemistry of Natural Products—New Delhi, India—6-12 February, 1972.
7. Eighth International Congress on Clinical Chemistry—Copenhagen, Denmark —19-23 June, 1972.

NATIONAL COMMITTEE FOR CHEMISTRY

Dr. A. Rafter has been elected Chairman of the National Committee, following the death of Professor Packer who held that office.

Other members of the Committee are Professor L. H. Briggs, Mr. S. G. Brooker, Dr. W. McGillivray, Dr. F. B. Shorland, Professor J. W. Tomlinson and Professor C. J. Wilkins.

BRANCH NOTES

Auckland

N.Z. Fertiliser Manufacturers' Research Association

Dr. A. P. Mair joined the staff recently. He is a physical chemist who completed his Ph.D. at the University of Canterbury in 1963 and did 2 years post-doctoral study in the Chemistry Department, Princeton University. For the past 5 years Dr. Mair was employed at Caruthers Research Laboratory, E. I. du Pont deNemours and Co., Wilmington, U.S.A. At N.Z.F.M.R.A. Dr. Mair will study the extraction of phosphorous and other materials from the alumino-phosphate ores of Christmas Island.

Fume Cupboard Chemistry

Mr. Ron Hicks celebrated his retirement from the position of Chief Chemist and Treatment Works Superintendent, Auckland Regional Authority, by giving a lively address to the Auckland Branch. Mr. Hicks reviewed recent developments in sewage treatment and pollution control, paying particular attention to the harnessing of natural processes, such as aerobic oxidation in activated sludges, to treat wastes in an economic fashion. He delighted his audience with anecdotes and aphorisms gleaned from long experience in the treatment of sewage and other wastes. Who else could have better summed up the inevitability of industrial effluent by quoting the Yorkshire proverb: "Where tha's mook tha's brass"?

University

A refresher course on *Chemistry Today* for secondary school teachers was held in May. The course was attended by 43 teachers who took part in a series of lectures, seminars and laboratory sessions over a period of five days.

Waikato

Professor F. L. Warren, Dean of the Faculty of Science at the University of Capetown, is at Ruakura Agricultural Research Centre on a National Research Advisory Council Fellowship. At Ruakura Professor Warren is working on *Senecio* alkaloid chemistry.

Dr. B. B. Marsh has resigned from the Meat Industry Research Institute to take up a position overseas.

At the University of Waikato the second block is now occupied.

The latest addition to the staff is Dr. Alan Langdon who was previously at the University of North California. Professor A. T. Wilson, head of the Chemistry Department, is returning in June from study leave at Denver, Colorado.

The Waikato Branch has recently been addressed by Mr. C. F. Denmead, Meat Industry Research Institute, on "Water Pollution Control—Ways and Means", and Dr. D. F. Nelson, Chemistry Division, D.S.I.R., on "Science in the Investigation of Crime".

Manawatu

Last year the branch agreed to the establishment of a prize for the best student in third-year chemistry at Massey University. The first award was made this year to Mr. R. S. Humphrey.

Applied Biochemistry Division, D.S.I.R.

Dr. P. J. Peterson has been appointed to a Chair in Botany at Westfield College, University of London. He is to take up his appointment at the beginning of October.

Dr. K. A. C. James has been appointed to the Staff after completing a Ph.D. at Monash University under Professor L. A. C. Austin on Protein Biochemistry. He will be working with Dr. J. W. Lyttleton on the biochemistry of the photosynthetic pathway.

Dr. A. Ejan is visiting the Division for a year. He is from the Waite Agricultural Institute, Adelaide, and is interested in the nutritional biochemistry of amino acids in the ruminant.

Dr. J. G. Robertson has recently returned from two years leave in the U.S.A. He spent the first year at Roswell Park Memorial Institute, Buffalo, New York, with Professor D. F. Parsons. This cancer research institute has a professional staff of close to 500. He spent the second year with Professor L. I. Rothfield, Department of Microbiology, at the University of Connecticut Health Center, Farmington. Since his return he has been working on the structure and function of bacterial membranes and their constituent proteins and enzymes.

New Zealand Dairy Research Institute

Dr. R. C. Lawrence is visiting a number of research institutions in both the U.S.A. and Europe.

At the invitation of the Scottish Milk Marketing Board he is spending additional time in Scotland helping them with their single strain starter programme.

Dr. D. F. Newstead has been awarded the degree of Doctor of Philosophy by Massey University. His thesis was entitled "A study of Mouse Blood Proteins in Inbred Strains 101/FaMac, NZB/Bl and NZY/Bl".

Dr. N. J. Walker will present a paper at the 1971 A.N.Z.A.A.S. Congress at Brisbane. He will then visit a number of research units of interest in other parts of Australia before returning to New Zealand.

Following recent staff changes, the Institute has been re-organised on a product-orientated basis rather than on the previous discipline-oriented basis. To this end all the research officers were put into a number of sections and these have been grouped into two large divisions of fundamental and applied research. The services sections and processing hall staff were largely unaffected by these changes. The new positions created by these changes and those filling them are listed:

Supervisor of Fundamental Research, Dr. R. C. Lawrence.
Senior Microbiologist, Dr. L. E. Pearce.
Senior Chemist, Dr. L. K. Creamer.
Supervisor of Applied Research, Dr. R. M. Dolby.
Product Development Co-ordinator, Dr. W. B. Sanderson.
Senior Engineer, Mr. R. S. Jebson.

The following are the new Sections and their leaders:-

Biochemistry, Dr. T. D. Thomas.
Protein Chemistry, Dr. L. K. Creamer.
Flavour Chemistry, Dr. N. J. Walker.
Starters and Bacteriophage, Dr. L. E. Pearce.
General Microbiology, Dr. T. F. Fryer.
Butter and Milkfat, Dr. R. M. Dolby and Mr. R. S. Jebson.
Casein and Related Products, Mr. C. R. Southward.
Milk Powders, Dr. W. B. Sanderson.
Whey Products, Dr. K. J. Kirkpatrick.
Analytical Chemistry, Mr. A. K. R. McDowell.
New Uses and Product Evaluation, Miss M. A. Humphries.
Containers and Packaging, Dr. P. S. Robertson.

Massey University

Professor E. L. Richards was recently appointed to the Chair of Food Technology. He is also the Director of the Food Technology Research Centre.

Professor D. S. Flux has been granted a year's leave to work with Dr. A. Cowie, Department of Physiology at the National Institute for Research in Dairying, Reading, England.

Dr. G. G. Midwinter has been awarded a Commonwealth Universities Travel Grant for study leave at the Medical Research Council Unit of Molecular Biology at the

University of Cambridge. He will be working with Dr. B. S. Hartley on rapid sequencing techniques for proteins using mass spectrometry, a technique already in use at Massey.

Dr. R. D. Reeves is to spend a year on study leave at the University of Florida, Gainesville, working in the field of atomic absorption and atomic fluorescence spectroscopy. He will attend the 1971 A.N.Z.A.A.S. Congress in Brisbane before proceeding to North America.

Mr. J. D. Hocking, a recent graduate from the Department of Chemistry and Biochemistry has been awarded the 1851 Exhibition Science Research Scholarship for New Zealand for 1971. He is now working at the Medical Research Council Unit of Molecular Biology at Cambridge University.

Wellington

Chemistry Division

In April, an unusual but stimulating lecture entitled "Social Responsibility and the Scientist" was given by Mr. Shallcrass of the Education Department, Victoria University.

A Hilger and Watts four-circle single crystal X-ray diffractometer has recently been purchased by Chemistry Division for X-ray crystallography studies, especially of organic compounds. The instrument is controlled by a PDP8-I computer with 8K words of store. A new, very highly stablised X-ray generator has also been installed for use with the diffractometer.

Dr. P. B. Udy has been appointed to the Pesticides Section. After taking his B.Sc. at Victoria University, Dr. Udy proceeded to King's College, London, where he completed a Ph.D. which involved a study of some phosphonitrilic compounds. At Chemistry Division he will be involved in formulating insecticides and in a study of insecticide dispersion in soils.

Dr. J. Hemmingson has returned to the Organic Chemistry Section after completing post-doctoral studies at the University of Oregon. At Eugene, Dr. Hemmingson studied Iodine Exchange between molecular iodine and benzhydryl iodides in hexane, under the supervision of Professor R. M. Noyes.

Mrs. S. Watson, an M.Sc. graduate in Biochemistry from Victoria University, has recently joined the Food Section. Since leaving university, she has worked for a private pathologist in Auckland and also in the Biochemistry Laboratory at Sydney Hospital.

Chemistry Department, V.U.W.

Lectures given in the Department by visitors during March and April included "Chemistry of the Atmosphere" by Professor L. F. Phillips, University of Canterbury; "Colourful and Creative Chemistry on a Cold, Calculating Computer" by Dr. J. Bailey, Chemistry Division; and "The Rates of Fast Reactions in Solution" by Dr. W. S. Metcalf, University of Canterbury. Professor W. S. Fyfe, Royal Society Professor of Geochemistry at Manchester University spoke on the application of thermodynamics to geochemistry, and Dr. W. T. Robinson, University of Canterbury, gave a state of the art lecture on X-ray crystallography.

Otago

Three new staff members have joined the Chemistry Department of the University of Otago. Mr. V. J. Alexander has taken up a lectureship in Applied Chemistry following a year on the lecturing staff of the Chemical Engineering Department of the University of Canterbury. Mr. Alexander comes to Otago with a strong teaching background and interests in coal gasification.

Another new member of the Chemistry Department staff is Dr. E. G. Jones, lecturer in physical chemistry, who arrived early in May. Dr. Jones completed a Ph.D. at the University of Western Ontario, and has lectured for two years at the Royal Military College, Kingston, Ontario. He comes to Dunedin from Ottawa, where he held a Research Fellowship in the Chemistry Division of N.K.C. working under Dr. G. C. Benson. Dr. Jones interests are in thermodynamics, especially non-electrolytes and polymers.

Dr. R. G. Cunninghame has returned to the Chemistry Department after two years overseas. He left in 1969 to complete a Ph.D. degree under Sir Ronald Nyholm at University College, London. On completion of his degree Dr. Cunninghame worked at the Faculty of Industrial Chemistry, University of Bologna, Italy, for 15 months. He worked with Professor U. Belluco on organometallic chemistry.

Dr. D. V. Fenby has returned from leave spent at the State University of New York, Stoney Brook, N.Y., where he worked with Professor B. Chu on laser scattering in the critical region. He broke his return journey to lecture for a short period at the University of Ceylon, Colombo, under Colombo plan sponsorship.

The visiting Mellor Professor in the Chemistry Department for 1971 is Dr. B. F. G. Johnson from Cambridge University. Professor Johnson arrives in Dunedin on 23rd June and will spend about five months in this country. His research interests lie in the field of organometallic chemistry, especially the reactions of co-ordinated organic molecules.

Dr. R. Laverty of the Department of Pharmacology, has been awarded a Commonwealth Medical Fellowship and leaves in August to spend a year in the Department of Pharmacology of Cambridge University. Dr. Laverty will study factors influencing the metabolism of catechol amines with Dr. Brian Callingham.

Dr. H. Taylor has been appointed Associate Professor in the Department of Pharmacy. Dr. Taylor comes to Otago from the Pharmacy School of the Central Institute of Technology.

Drs. P. A. Sullivan and D. W. Russell of the Biochemistry Department of the University attended the Annual Conference of the Australian Biochemistry Society which was held in Brisbane from May 17th-20th. Both presented papers on aspects of enzyme reactivity. Two Ph.D. students from the Biochemistry Department also presented papers at the Conference.

Construction of new buildings in the University of Otago proceeds at an unprecedented rate. Among projects of interest to chemists is the new Biochemistry Department building, which is well up to schedule and should be completed by the end of this year. Undergraduate biochemistry teaching will begin in the new building in 1972.

The eight-storey Chemistry Department "Phase 2" building is also up to schedule. This building, which is to contain staff and research facilities, etc., is due to be completed by 1973.

The new Medical School Library building should be completed by the end of this year.

Construction has also started on the Medical Science Building, an 80,000 square foot, seven-storey building costing about 2 million dollars. Completion date, end of 1972.

In the planning stage, but also of interest to chemists, are three more building projects on the campus —

The New Science Building, a complex to house Departments of Physics, Botany and Mathematics, and also a temporary Science Library. Cost, about 5 million dollars. Design reports, etc., are now being prepared.

The new Ward Block of the Dunedin Hospital, part of which will be a Medical School "Component" is also at the design report stage. Completion date, 1977-78. Very approximate cost, 15 million dollars.

A new Microbiology Department building, planned completion date 1975.

In addition to these, an extensive internal reorganisation of Medical School building facilities is now in progress.

The "Phase I" Chemistry Department Building was completed in February of this year, and all undergraduate laboratory classes are now held in this building. The Micro-analytical laboratory under Dr. A. D. Campbell is also situated in the Phase I building, as is the radiochemical suite. One feature of the building is the Applied Chemistry Laboratory, which has permitted the introduction of new courses in this branch of Chemistry. Applied Chemistry is now studied by *all* B.Sc. (Hons.) chemistry students in their second and third years. An optional fourth year course is also available. General B.Sc. degree students can include up to two units of Applied Chemistry in their degree.

Personal

Many Otago Branch members were delighted at the visit of Professor W. S. Fyfe, F.R.S., to Dunedin in April. Professor Fyfe, a graduate and former staff member of the Chemistry Department, is now Royal Society Professor in Geochemistry at the University of Manchester. In addition to lectures in the Geology Department he gave a well attended public lecture in Dunedin entitled "Experiment and the Crust of the Earth".

The Registry

The following were elected at the Council Meeting of 30/4/71:

Fellowships:

DASENT, Wilfred Effingham, M.Sc., Chemistry Dept., Victoria University, Wellington (Reader).

HALSTEAD, Norman, M.Sc. (Salford), F.R.I.C., Dannevirke High School (Head of Chemistry Dept.).

HAY, Robert Walker, B.Sc. (Hons.), Ph.D. (Glasgow), F.R.I.C., Chemistry Dept., Victoria University, Wellington (Reader).

WONG, Edmon, M.Sc., Ph.D. (N.Z.), Applied Chemistry Division, D.S.I.R., Palmerston North (Head, Natural Products Section).

OSBORNE, Graham Oliver, B.Sc. (Hons.), Ph.D. (Wales), Entomology Dept., Lincoln College (Senior Lecturer).

Associates:

CROPP, Peter Laurence, M.Sc. (Well.), Biochemistry Dept., Victoria University, Wellington (Ph.D. Student).

GALLAGHER, Rex Thomas, M.Sc. (Auckland), Dept. of Chemistry and Biochemistry, Massey University, Palmerston North (Lecturer).

HALTON, Brian, B.Sc. (Hons.), Ph.D. A.R.I.C., Chemistry Dept., Victoria University, Wellington (Lecturer).

McCALLUM, Neil Keith, M.Sc. (Auckland), D.Phil. (Oxon), Chemistry Division D.S.I.R., Auckland (Scientist).

MILBANK, Arthur John Gorham, M.Sc. (Auckland), Dilworth School, Auckland (Teacher).

PRIOR, Michael John, B.Sc., M.E. (Chem.), G. L. Bowron and Co. Ltd., Christchurch (Chemist).

RUSSELL, David Warwick, M.Agr.Sc. (N.Z.), M.S., Ph.D. (Yale), Biochemistry Dept., Otago University, Dunedin (Lecturer).

THENG, Kian Goam Benny, B.Agr.Sc. (Hons.), Ph.D. (Adelaide), Soil Bureau, D.S.I.R., Lower Hutt (Scientist).

YUNG, Yuen Hoy, B.Sc. (Hons.) (Melb.), Dip.Ed., Upper Hutt College, Upper Hutt (Teacher).

RAINSFORD, Kim Drummond, B.Sc. (Hons.), Ph.D. (Lond.), Dept. of Biochemistry, Victoria University, Wellington (Research Fellow).

Graduate Membership:

CAMERON, Roger Ewen, B.Sc., Fletcher Timber Co., Taupo (Development Chemist).

COLLINS, Desmond Michael, M.Sc. (Well.), School of Science, University of Waikato, Hamilton (D.Phil. Student).

CUTTEN, Anthony Eliot Cargill, B.Sc., Lincoln College, Canterbury (Post Graduate Student).

DALZELL, Kerry Wayne, M.Sc., Chemistry Dept., University of Canterbury (Student).

DRAKE, Linda Marie, B.Sc. (Hons.) (Cantuar.), Chemistry Dept., University of Canterbury (Student).

DOUGHERTY, Gavin James, B.Sc., Chemical Services Laboratory, Johnsonville (Racing Chemist).

MADDEN, Raymond James, M.Sc. (Auckland), BALM Paints (N.Z.) Ltd., Auckland (Technical Officer).

RANKIN, Robert John, B.Sc., K.P. Fertiliser Works, Hornby (Chemist).

Exemption from subs: N. P. Alcorn, B. W. Doak, C. P. Radcliffe, F. B. Thompson, N. V. B. King.

Deaths—The following deaths were noted with regret: E. Freyberg, J. Packer.

Resignations: B. P. Caughley, R. J. Wells, J. E. Cornish, A. C. H. Dobson, H. N. S. Burton, Mrs. G. R. Burns, B. Marsh, P. Peterson.

Deleted from Registry: D. F. Murtz, J. R. McDonald, P. J. McElroy, R. S. Wilson.

VISIT BY DR. MONTY BARAK

Dr. Barak, former New Zealand Rhodes Scholar, now an international authority on electrochemistry, visited New Zealand recently to conduct seminars on the modern techniques and applications of lead storage batteries. Until recently Dr. Barak was scientific adviser to the Chloride Group, of which Battery Makers of New Zealand is a wholly-owned subsidiary. His visit to New Zealand was sponsored by the Australian Lead Development Association.

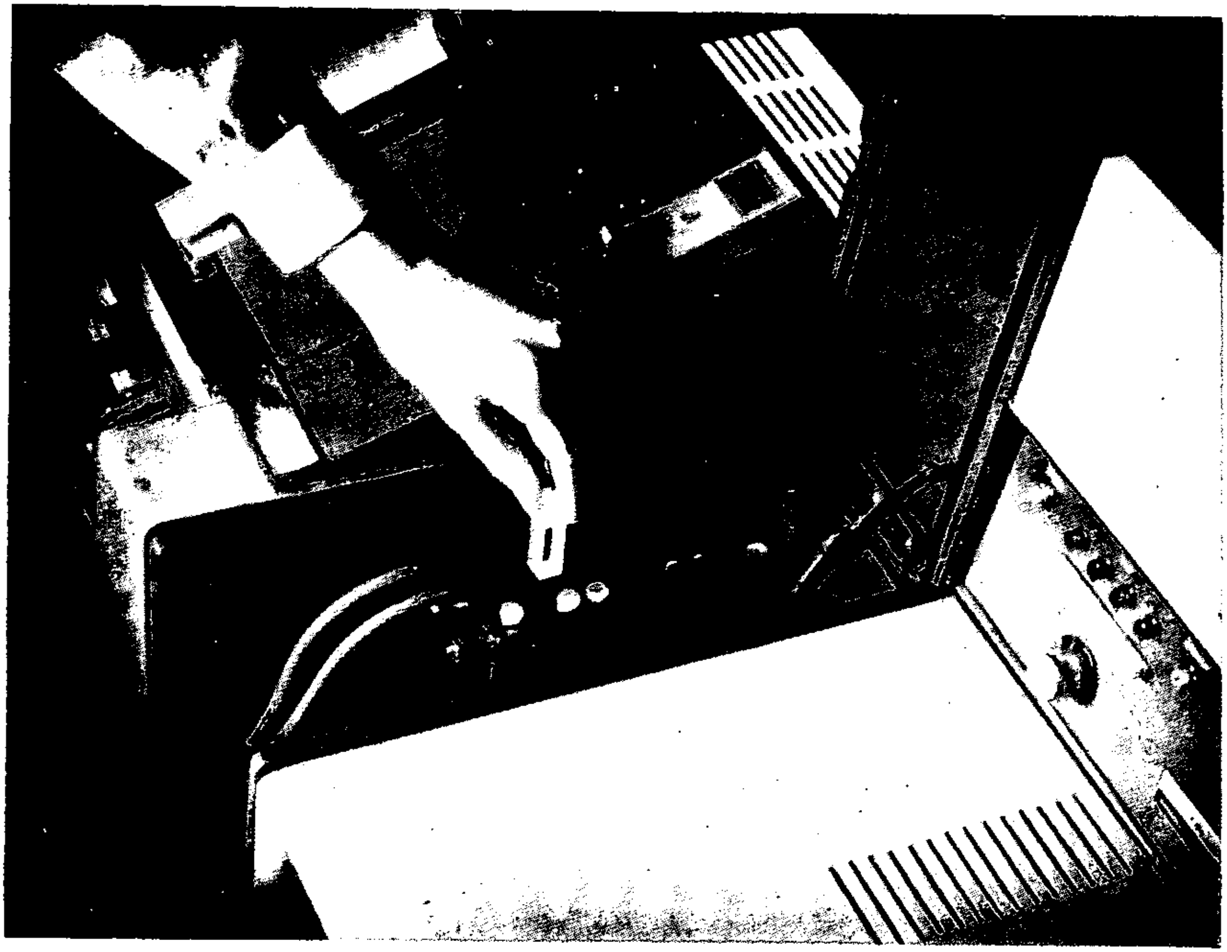
Dr. Barak spoke to meetings of several branches of the Institute. He said that traction batteries were being used to propel vehicles, not to just start them. In England there were 75,000 electric trucks on the roads, and an additional 50,000 commercial vehicles.

Of the industrial trucks in Britain 61% are electric. In Germany 45% of them are battery driven, in France the figure is 40%. In New Zealand it is only 13%.

Dr. Barak said that the electric vehicles were used in pharmaceutical food industries where it was important that contamination from pollution should be avoided. Tubular batteries were used with cell voltage and timing devices which allowed an adequate current flow. "They are used to a great extent on milk floats in Britain. The milkmen have to deliver early in the mornings, and they need quiet, clean vehicles for this,"

Dr. Barak added that a new approach to commuter traffic was demanded, and that the electric car could play an important role in reducing pollution and congestion. "In the United Kingdom, at least two towns are getting to the point where they may consider banning private cars from their city centres." While the internal combustion engined car would never be surpassed for longer distance travel, it was being looked on with increasing disfavour in urban areas.

Experiments were about to begin in Britain and other countries with battery-powered mini-buses; in West Germany a bus powered by a hybrid combination of batteries and a diesel-electric generator was being developed for urban and highway running.



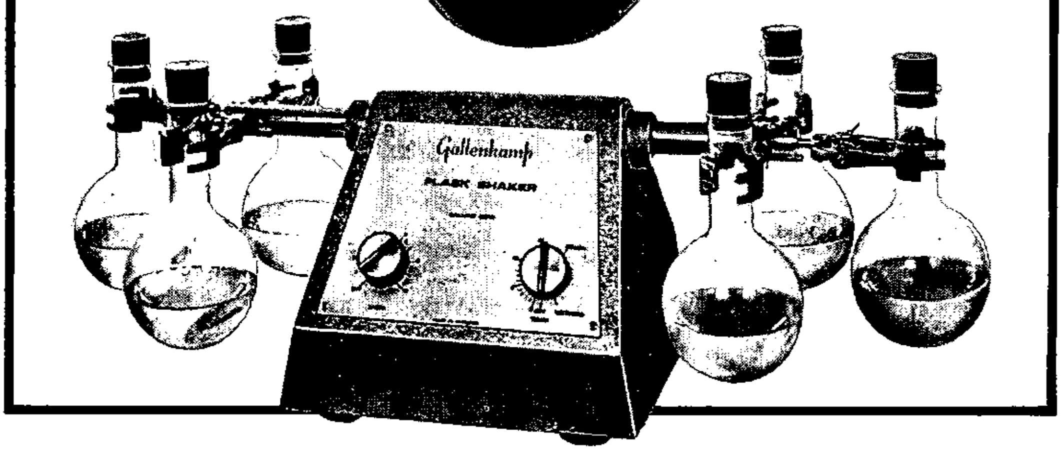
Gallenkamp
REGD. TRADE MARK

FLASK SHAKER

DISSOLVING

EXTRACTING

DISPERSING



- SIX POSITIVE GRIP CLAMPS MOUNTED 20cm ABOVE BENCH
- ADJUSTABLE SPEEDS UP TO 800 OSCILLATIONS/MINUTE
- LOW CENTRE OF GRAVITY ENSURES STABILITY WITHOUT EXCESSIVE WEIGHT
- BUILT-IN TIME SWITCH PROVIDES FOR PRESET SHAKING PERIODS UP TO 20 MINUTES OR CONTINUOUS RUNNING

SD-110

For 220/240V 50/60 Hz .... Each **£53.00**
For 110/120V 50/60 Hz .... Each **£55.00**

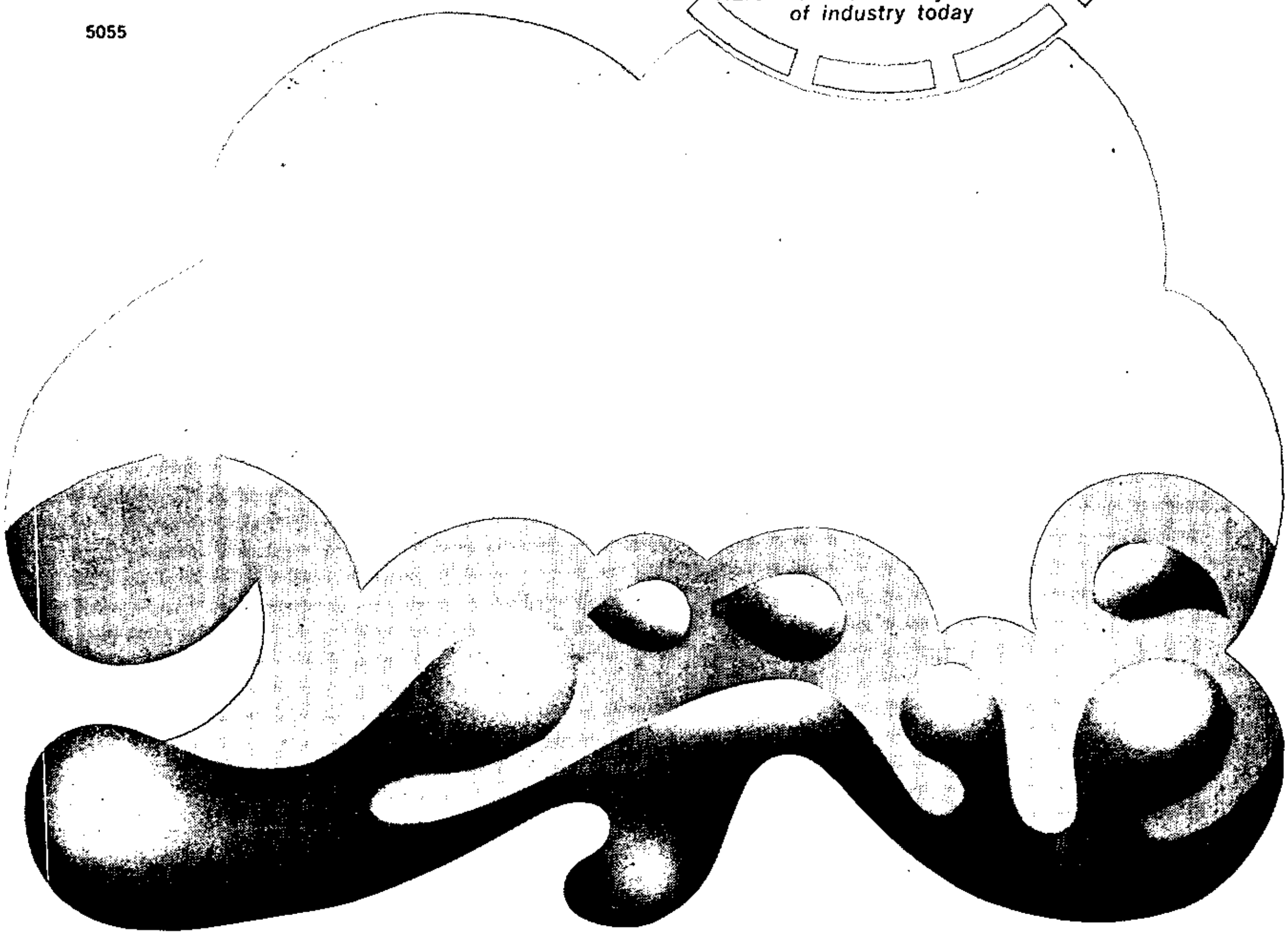
Other **Gallenkamp** shaking/stirring equipment includes:
Shaking incubator - Shaft and magnetic stirrers
Bottle shaker - Thermo stirrers - Vortex mixer
Please ask for details

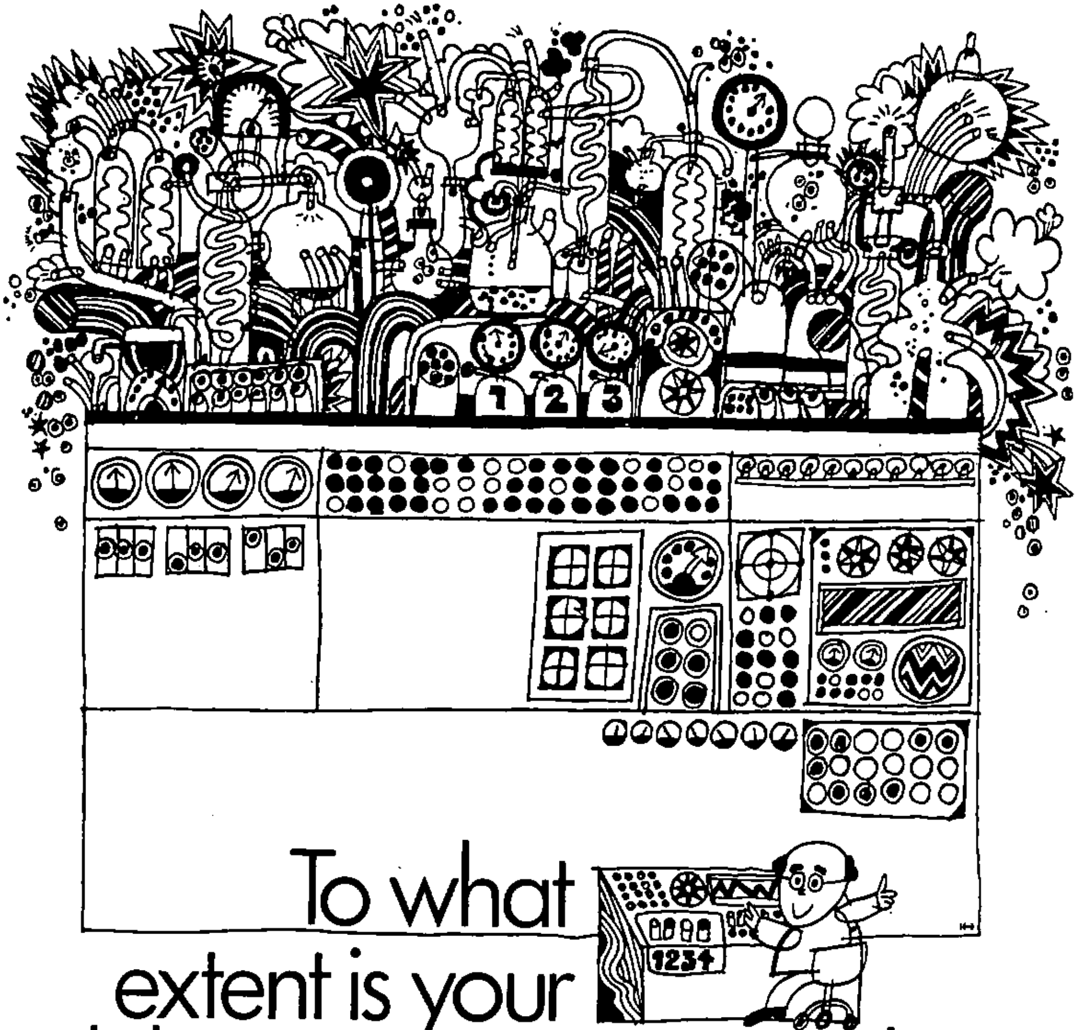
Appointed Distributors:
GEO. W. WILTON & CO. LTD.
Box 9071, Newmarket, Auckland.
Box 637, Wellington.

A. GALLENKAMP & CO. LTD.
Head Office:
P.O. Box 290, Technico House,
Christopher Street,
London,
EC2P 2ER. Telex 886041.

All orders accepted
subject to our published
Conditions of Sale.

Gallenkamp
REGD. TRADE MARK





To what extent is your laboratory automated?

A good many things have not yet been developed which you need in order to completely automate your laboratory. The 120 researchers in our laboratory are of the opinion that this will still take a few years.

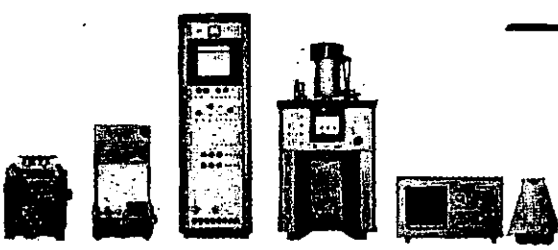
We made the first contribution to automation in 1946 with the first substitution balance which weighed samples ten to twenty times faster than the old two-pan balance. Innovations have been continuously added to Mettler balances. For example, the Mettler level-matic automatically compensates for level errors, the compact digital indicator speeds up the process of reading the results, the taring system shortens the weighing time.

If your time is still too expensive for reading off the result and writing it down, you can buy our printer balance. It prints out the result on an adhesive strip (accurate to five places). Or you can combine the Mettler with a recording device or a computer.

Some of the other Mettler measurement devices operate even more automatically than the balances. The Thermoanalyzer carries out TGA/DTG/DTA measurements simultaneously. All defining magnitudes and measurement values are drawn in colored curves.

The Mettler FP1 automatically determines melting and boiling points with an hourly capacity of more than 30 samples. It stores the measurement values digitally. The FP2 is for microthermal studies, and the FP3 automatically determines dropping points. (A bright note for the fat and oil industry.)

We have a few very new thermal and volumetric measurement devices in the research stage. A few are already in the torture chamber where we test every new measurement device with difficult endurance tests. After all, when one automates measurement processes, the automated measurement device has to really operate more dependably than the human being.



Mettler

SOLE AGENT

WATSON VICTOR LTD.

WatVic

Head Office: 4 Adelaide Road, Wellington.

Branches: Auckland, Christchurch and Dunedin.